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JOURNAL of FORESTRY

Vol. XXVII MAY, 1929 No. 5

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EDITORIAL

NEGLECTING THE HARDWOODS

STRANGE as it may seem, foresters have long been so thoroughly "pine-minded" that only a relatively few have recognized the economic and silvicultural aspects of the hardwood situation. It is high time for us all to adopt a broader point of view.

America was particularly blessed by nature with extensive and valuable forests of hardwoods that included numerous species of exceptional merit. Our white oaks, hickories, yellow poplar, hard maple, white ash, black walnut, and a few others are famous in all the important world lumber markets. Indeed it has been said that the world fame of American fixtures, horse-drawn vehicles, and wood-handled tools was founded more upon the hickory, ash, and oak used in them than upon their design and perfection otherwise. Europe's textile industry has drawn heavily upon our dogwood and persimmon, and the world's golf begins in our hickory trees. For a single make of automobile the body manufacturer's monthly hardwood requirements total 11 million feet, while the hickory requirements for automobile spokes are so formidable as to make us wonder where the wood all comes from.

If nature erred at all in giving us our hardwoods it was not on the score of their variety and intrinsic value, which are without rival in other temperate countries, but in almost wholly omitting so important a resource from the western forests. Economically, in fact, hardwoods now occupy a rather more strategic position than conifers, with less competition from substitutes, a more limited supply, and often higher prices. With certain species depletion has already proceeded to the point where the end of the supply of good high grade material seems perilously near. So acute, indeed, does the situation appear to those wood-using industries to which hardwoods are a necessary raw material that the American Society of Mechanical Engineers has taken a hand in seeking a solution of the problem. Its activity has assumed a not unusual form; overlooking, apparently, the possibilities of forest management in our own hardwood lands, it has turned its eyes to the discovery and exploration of new sources of virgin supplies in the tropics.

Full information as to the location, amount, properties, and usability of tropical species is doubtless highly desirable, whether these are destined to come to our shores, as many believe, as a welcome supplement to our own rapidly waning hardwood supply, or, as others

think more likely, as unwelcome competitors. In either case our position will be strengthened by a knowledge of the facts. It is even more important, however, to investigate as thoroughly and as promptly as possible ways and means of supplying our wood-using industries with home-grown materials and at the same time of maintaining the productivity of our hardwood lands.

One reason for our previous apathy concerning this undertaking unquestionably lies in the fact that in general our best hardwoods occupy the best lands. We have seen large areas cleared for cultivation (sometimes with, sometimes without, the use of the timber removed), until we have almost come to accept it as axiomatic that hardwood lands should be turned into farms as rapidly as possible. Efforts to cut conservatively and to take other measures to secure the perpetuation of the forest have therefore not seemed worth while.

This is, however, far from being the case. The troublesome farm problem is proof that we already have more land under cultivation than can be worked at a profit. It is extremely unlikely that any but a relatively small amount of the vast area of rich agricultural lands in the lower Mississippi Valley, for example, will be put under the plow for as long as two or three, and possibly more, rotations to mature crops of hardwoods. The same is true in other regions where virgin or second-growth hardwoods still occur on soils of promising agricultural value. Instead of clearing these, there appears to be an accelerated tendency to abandon both good and marginal land already in farms to the whims of nature and man. Many of these lands originally bore heavy stands of valuable hardwoods and may well do so again. The silvicultural importance of hardwoods in mixed stands and on non-agricultural lands should also not be overlooked.

The slow growth of hardwoods in virgin stands constitutes another reason for lack of interest in them because of the rather general impression it has created that the rotation periods would have to be excessively long. This is apparently not the case, for the accelerated growth of unmerchantable trees left by loggers, the satisfactory growth of newly established trees, and the possibility of utilizing hardwoods in small dimensions all indicate that new crops can be grown on rotations that compare very favorably with those for softwoods, while their values may be even greater. The silviculturist, however, will have a difficult problem to master because of the mixture of so many species of very divergent silvical characteristics and the great disparity in the intrinsic values of their woods.

It is gratifying to note the growth of interest in hardwood forestry, especially since the northern and eastern forest experiment stations were established, and to be able to record in this issue of the JOURNAL a first step in the South to learn more about the hardwood situation in the Mississippi Valley.

Keep on with the coniferous forestry but don't neglect the hardwoods.

THE ANTI-TRUST LAWS AND CONSERVATION OF NATURAL RESOURCES[1]

By BETHUEL M. WEBSTER, Jr.
General Counsel, Federal Radio Commission

I APPROACH this discussion with considerable enthusiasm, for it offers not only an opportunity to study a fascinating and significant subject, but relates very closely to work in which I have been engaged for some time.

At present, as General Counsel for the Federal Radio Commission, I am concerned with the conservation of the ether. Although the texture and character of this element is unknown, it presents, in effect, many of the actual and potential problems of use and conservation which are present in the use and conservation of the physical elements and the natural resources. The ether may be considered as a vast reservoir of space which must be economically administered for the benefit of the listening public. It may be regarded as an ocean highway, where the lanes are limited and require protection and policing to safeguard the interests of travelers. In some respects, it corresponds to our deposits of petroleum, which may be wasted for non-beneficial purposes. But in one respect it differs fundamentally from physical resources to which we are accustomed, for it is not subject to ownership or use in the usual sense of these words. It is circumambient and penetrating; it is elusive and invisible; and it is utterly hypothetical. In a fundamental sense, it can never be wasted, since it is not material or destructible.

I am also interested in this discussion because it involves a consideration of problems which were presented during my tenure as Special Assistant to the Attorney General. I came to Washington as assistant to Col. William J. Donovan, who was charged by law with enforcement of the anti-trust laws. During Col. Donovan's period as Assistant to the Attorney General a new philosophy of the relation between Government and business was gradually developed. Though we tried our best to insist upon vigorous enforcement where violation was clear, we tried also to make the facilities of the office available for the benefit of lawyers and business men whose experience in the field of anti-trust regulation was limited.

These laws form a difficult and uncertain section of our public acts, and represent a public policy which is somewhat difficult to define. It was our theory that these laws, which were enacted first in the nineties, should be constructively administered, in order not only to satisfy the intention of Congress, but also in order to make them helpful rather than harmful in the present day development of American business. During the last three years, the anti-trust division considered dozens of proposed mergers, trade

[1] Presented before the Washington Section, Society of American Foresters, Washington, D. C., April 26, 1929.

associations, etc., for the purpose of determining in advance whether the projects involved constituted a violation or a threatened violation of anti-trust acts. And in many cases, without expressing our opinion or approval in formal terms, we indicated to American business men that the plans they had in mind would not warrant prosecution under the anti-trust laws. Such plans were carefully considered by a committee of our division and before our conclusions were transmitted to the interested parties all factors were carefully and fully considered.

Such an expression from our office had the effect, first, of putting stockholders and potential stockholders at ease with reference to the plans of the companies concerned; second, it satisfied bankers who were planning to underwrite or sell any securities which were involved; and third, it gave a degree of solace to lawyers who were responsible for the legal details of such enterprises. Anti-trust law is a specialized field, and there are few lawyers who can advise their clients of the propriety of proposed action with any degree of confidence if the anti-trust statutes are involved.

In an address delivered in October, 1927, Col. Donovan summarized our work as follows:

> "On the legal side the Department of Justice has made clear that it considers it to be its duty to examine into all proposals of organization and methods, to meet at the threshold those problems that the business man desires to solve without violation of the law."

I also have deep sentimental reasons for being interested in this subject. For the first 20 years of my life I lived in Denver, Colorado, a city to which my father had gone as a pioneer, and a city in which I naturally fell heir to a love for the mountains and forests as well as the plains. As a small boy I spent summers in or near the national parks and forest reserves, and at one time I contemplated a career in the Forest Service. When I think of the freedom and pleasure of a forester's life, I regret that fate turned me away from a boyhood ambition. I have camped in the center of beautiful mountain regions which have been swept and destroyed by forest fires. I know the terror and waste which this occasions; and I deeply appreciate the economic significance of improper lumbering methods. I have been in the great Northwest, and have seen the effects of uneconomic and selfish destruction of timber.

Moreover, I am impressed with the fundamental importance of conservation as it affects this country. As I stated before, each of the natural resources upon which we depend is affected with many of the same problems.

In the case of water, the effort to make a limited supply take care of almost unlimited demand is still unsolved. I recently spent some time with Col. Donovan at Bishop's Lodge, Santa Fe, New Mexico, where as Chairman of the Rio Grande and Boulder Dam Commissions, he was attempting to adjust the interests of western states in the waters of the Colorado and Rio Grande Rivers. I was specially impressed with the vigor with which the claims of the various states were presented. To the people of the West, water is a matter of life and death, and if this were not a union of states, I am sure that in the past these conflicting interests would have led inevitably to

war between the people residing in the various watersheds. But I have a feeling that the question of conservation, in so far as it relates to water supply, will end in a satisfactory settlement. I am told that the Rio Grande dispute is approaching a settlement after years of disturbance and negotiation. The states are recognizing each other's rights. They are conciliating rather than fighting, and in some instances they are accepting compromise rather than complete loss. The Boulder Dam question, which is so tremendously vital to the people in the states through which the Colorado River flows, has not been settled; but I am advised by well-informed persons that this situation may be brought to a satisfactory conclusion within a reasonable period of time. The states must, in order to insure the maximum use of the waters of this river, enter into some kind of an agreement which will guarantee freedom from dispute in the future.

It is unfortunate, perhaps, for the interest of this Society, that such great emphasis has been placed upon the problem of conservation of oil. It has withdrawn public attention from the need for conservation of our forests. Nevertheless, petroleum is a vital commodity and represents pressing interests; and in so far as suggested plans for solution of its problems can be adapted to similar problems affecting forestry, it will be of service to us. There is no industry as active or as rich as the petroleum industry, and there is no industry more keenly aware of the need for conservation. Many plans have been proposed, many plans have been discarded, and the latest suggestions have received the serious consideration of the President, as well as members of the Cabinet. The Federal Oil Conservation Board was appointed by President Coolidge to study the whole problem, especially overproduction, and offer constructive suggestion for its solution. This Board has the able assistance of George Otis Smith, who is now traveling in the West for the purpose of seeing whether the governors of the principal oil states—California, Arizona, Oklahoma, and Texas—would be favorably inclined toward an interstate compact dealing with the question of conservation. The Board also studied the problem of waste, both in drilling and use, and is satisfied that a uniform system of regulation would help materially in preventing cutthroat competition, off-set drilling, and improper development of wells. President Hoover has ordered a re-examination of all drilling under Government permit on public lands, and the Secretary of the Interior, speaking unquestionably with the authority of the President, asserted that an investigation would be made to determine whether the compensation received by the Government is sufficient, whether the permits obtained from the Government are unfair or fraudulent, and whether the public policy favoring conservation of oil reserves will be advanced by further use of the permit system.

I have spoken only of federal action. It is well known that the industry itself fully appreciates the necessity for some form of regulated and uninterrupted conservation. The American Petroleum Institute, meeting in Houston last month, approved a plan whereby the principal producing companies would limit the 1929 production to the level established in 1928. This would appear to be a reasonable limitation but, as you no doubt know, it involves consideration of

the anti-trust laws, and it is doubtful if it can be carried into effect. Members of the industry deny that they are trying to increase the price unreasonably, in view of the emergency which exists; but it is nevertheless true that a plan for limitation of production which has the effect of increasing prices, however noble the motives of the planners, is a combination in restraint of trade within the meaning of the Sherman Act, and is therefore illegal. The Supreme Court has held that reasonableness of price is not a factor; the only question is whether the plan is intended to eliminate competition. A scheme to fix prices, or to divide territory, or to divide customers, or to limit production is illegal *per se,* regardless of the fact that the consumer may ultimately pay a fair price for the article involved.

The American Petroleum Institute also formed a committee consisting of representatives of the Government, the American Bar Association and the industry to consider the recommendations of the Federal Oil Conservation Board, and to advise the Institute specifically of available methods of control. The committee came to the conclusion that the Federal Government has no authority whatsoever—that the drilling of oil is an intrastate rather than in interstate matter—and that regulation must take form under state rather than federal legislation. This was a discouraging conclusion, and was brought about, no doubt, through a fear of anti-trust legislation. It fails to take into consideration the fact that economic necessity requires uniform regulation. Competition in the production of oil is so fierce that regulation which affects only a portion of the industry will increase rather than solve the problem. If the State of Oklahoma passes restraining legislation, its fields will be partially abandoned, and those in California and other states will be more fully and less economically exploited. If drilling is regulated in California, because of competition in the industry the money required by the regulation in that state will be saved on operations in other states. If one state accepts the theory of underground storage, adjoining states which have failed to accept that policy will develop wells at the expense of the state having the regulation. There never was a situation, except perhaps in the lumber industry, where a uniform policy of conservation was more greatly needed. At the present time, owing to the frantic development of fields, drilling is unscientific, storage is wasteful, and refining is uneconomically carried on. I am informed that, by installation of proper refining methods, gasoline derived from crude oil may be materially increased, yet at present there is no incentive for the use of such methods.

I have dwelt at some length on the problem of conservation as it relates to the petroleum industry because I feel that many of the same problems are involved in the conservation of our timber resources. It has been said that we have reduced by seven-eighths the virgin timber which was standing when this country was discovered. I am told that less than 150,000,000 acres of virgin timber are now standing; that half of this acreage is controlled by private interests which provide 97 per cent of the lumber demands of this country. The other half is located on the public domain, and there, to a certain extent, conservation is taking place in control of cutting and sawing, in fire prevention, and in refor-

estation. Owing to intense competition of private interests, lands which are privately owned are being exploited at a high rate of speed, with little or no provision for the future. In Major Ahern's pamphlet I note that it is estimated that the timber resources of the South, at the present rate of destruction, will last for a period of about 10 years, while those of the Northwest are expected to be exhausted within a period of approximately 25 years. Some members of the lumber industry are complacent, or sanguine, some are palpably dishonest. They say that new crops will meet the regular demand, and that conservation in the form of reforestation is expensive and unnecessary. I don't pretend to be a master of the industry—in fact, I am a novice—but judging from my own observation, natural reforestation is a slow, laborious, and wholly fortuitous process, and will never satisfy the requirements of this country. Moreover, unless some form of uniform control is installed, natural reforestation will never replace timber which is wasted by destructive logging practices, uneconomic slash, forest fires, and frenzied liquidation of timbered holdings. In this connection, I am going to quote from an article by M. L. Requa, which appeared in a Sunday issue of the New York Times. If the words "lumber industry" are substituted for the words "petroleum industry," the article has a direct application to the problem before us:

"The petroleum industry, in fact nationally and internationally, needs a program based upon the experience of our life insurance companies, our banks, and our railways. Any suggestion that our great life insurance companies abandon the system of level premiums and adequate reserves, and adopt the assessment premium system with no reserve, would not receive even the cold courtesy of a respectful hearing.

"A proposal to go back to the old banking system in vogue in the days when the notorious 'shin plasters' were in circulation, and bank notes were of no value beyond the confines of the state in which the bank of issue was located, and often of little value even there, would be hooted down and the individual making such a proposal would be looked upon as a fit candidate for the lunatic asylum. Even a proposal to return to the banking system in use prior to the passage of the Federal Reserve act would be dismissed as unworthy of consideration.

"Any suggestion that our railways go back to the old conditions of secret rebates and disorganized tariffs that made it impossible for a shipper to know what rates his competitor was paying would equally receive no serious consideration.

"To all intents and purposes the petroleum industry operates under the assessment life insurance plan. Its price fluctuations resemble the temperature chart of a typhoid fever patient; the bringing in of a new field instead of being the source of congratulation and rejoicing, and an asset to be held in reserve, is viewed by the industry as a disaster because of its demoralizing effect on the price structure. Like the banks of the old 'shin plaster' period, it operates over the long view without proper reserves and, like the railways of the old days, it is the victim of cutthroat competition that in the long run is detrimental to everybody. If present-day practice in the petroleum industry is economically sound, then the methods of our life insurance and railway companies and our banks are utterly and fundamentally wrong.

"Petroleum companies occupy a position of perhaps equal significance as compared with the three institutions above mentioned, yet in the past there have been no 'rules of the game,' no standards, no code of ethics. It has been a case of acute individualism, with every one doing about as he pleased or was finan-

cially able to do, with no regard for co-operative effort. The picture is one of frenzied effort to produce and sell irrespective of the requirements of the market. The conception that petroleum is one of our greatest mineral resources and its production and distribution a matter of public concern that must be administered as a trust in behalf of all of the people has only recently been accepted by a large part of the industry. Whether existing laws will permit the industry to make this trusteeship effective is a matter for immediate determination."

Having reviewed the problem itself, we next come to a consideration of suggested reforms. From time to time in this country it has been suggested that direct governmental interference and control is the only solution of the problem. These suggestions frequently come from persons who are familiar with the European economic system. Such suggestions have the merit of offering a direct and effective solution, but they are open to serious objections. In the first place, direct government interference and control of national resources is opposed to fundamental public policy in this country. Governmental control is opposed by President Hoover, as a restraint upon private initiative and development. He has unmistakably expressed his opposition to any form of interference, or control, or regulation, or subsidy which amounts to state socialism. He believes that this country has obtained and will obtain its fullest development through the operation of private ambition and energy. Public policy underlying the anti-trust laws is unquestionably an expression of the same philosophy. They were enacted on the theory that governmental operation was a bad thing; that the industries of the country would benefit from competitive individual enterprise; that combinations limiting competition were an evil thing. Otherwise, if competition were restrained by agreement, if monopolies were attempted or obtained, if consumers were placed at the mercy of industrialists, the Government would be compelled to interfere and exercise a high degree of control—all of which is opposed to public policy. Now, however, although the anti-trust laws were intended to prohibit combinations of industrialists, they have the effect of preventing many schemes which contemplate conservation through concerted action. The way in which the anti-trust laws may be utilized *for the benefit of industry* will be discussed hereafter, but in this connection it can be said that they are a definite statement against governmental interference—they are based on the proposition that the Government must interfere if competition may be restrained by private agreement. In this connection the conclusions of the Committee of the American Petroleum Institute are persuasive. As stated before, this Committee, representing the Government, the American Bar Association, and the industry, recommended that the problem of regulation be left to action by the states.

Of course governmental control can be carried on where the lands in question form part of the public domain; and it is hoped that the policy of the Government with reference to such holdings will also favor conservation in all its forms as against wasteful exploitation.

The second suggestion involves various forms of state control. As heretofore stated, it is practically impossible to install a satisfactory and uniform code of law which may be enacted in the lumber producing states. Such legislation is to

often the creature of immediate political considerations and frequently disregards underlying scientific considerations which must be incorporated in any satisfactory form of regulation. On the other hand, there is great merit in the state-compact idea. It is entirely possibly that the lumber producing states can be convinced of the desirability of such a compact, in which the advantage of uniformity would be attained, and in which the national Government would not necessarily be involved, except in so far as it approved, as required by law, the compact in question. In any case, progress can be made through a correlation of federal, state, and local agencies interested in lumber conservation. I would be the last to discourage such coöperation—but it has definite limitations.

In reference to solution by individual action, I must again remind you that the anti-trust laws are absolute in their prohibition against contracts and combinations whereby prices are fixed, production is limited, territory is divided, or customers are allocated. This discussion would be incomplete without a reference to the opinion rendered by the Attorney General, Mr. Mitchell, pursuant to a request from the Secretary of the Interior, Dr. Wilbur, for an opinion regarding the proposal of the Petroleum Institute. In response to Dr. Wilbur's letter, the Attorney General held that the Federal Oil Conservation Board has no power under the law to sanction the proposed agreement limiting production to the 1928 level. He also held, in view of the fact that the Federal Oil Conservation Board is not an executive department, that it would be improper for him as Attorney General to express an opinion as to whether the plan itself was legal or illegal. I must remind you that the Attorney General has no power to advise any one other than the President and heads of executive departments. When we, as members of the anti-trust division, considered proposed plans involving possible violation of the anti-trust laws, we made it perfectly clear that we expressed no opinion, but were simply advising the persons involved that the plan presented did or did not warrant present action for violation of the law. We conceded that we had no power to bind the Government, and we warned the parties that our expression was based upon an assumption that the facts had been fully disclosed.

I must not fail to refer briefly to the European system, which involves in many cases a form of conservation by coöperative action between individuals. The ordinary European cartel is nothing more than a trade association, such as we are familiar with in this country, with additional power which our trade associations do not possess, to enter into arrangements for limitation of production and fixing of prices. The cartel system has grown up under an economic philosophy which differs materially from our own. The theory abroad is, that so long as combinations in restraint of trade tend to stabilize the market and prevent uneconomic exploitation they are legal, whereas in this country all such agreements are condemned. The cartel in this elaborate form could never be used in this country so long as the anti-trust laws remain in force, and therefore is unavailable as a solution of our problem.

Moreover, the history of such institutions as the German Potash Syndicate and the Rhenish-Westphalian Coal Syndicate presents vivid evidence of the fact

that, with the development of cartels and trusts under the European system, there comes a time when the state itself becomes jealous of the economical, political, and social position of industry, and rigid governmental control invariably ensues. This may be an efficient thing; it may be a stabilizing thing; but it is so definitely opposed to accepted public policy in this country that it is clearly impracticable and unavailable for the solution of our problem. We must utilize existing legal and public facilities; we must be realistic and practical.

It is fair to say that the lumber industry has not made the fullest use of its trade associations to do constructive work on the problem of conservation. The trade associations may take a fairly active interest in taxation and reforestation problems. As stated in the Department of Commerce book on trade associations, the two are closely related, for taxation of timber strictly on the basis of stumpage value puts a premium on immediate cutting and discourages commercial reforestation. Taxation more on the basis of yield when the cut is made is felt by most lumbermen to be more in the public interest. Fire protection in forests and aids to tree planting on the part of state governments, through the maintenance of state nurseries and state forest services, are also encouraged by lumbermen as measures for the conservation of lumber and continuation of supply.

I think I have been more than fair in this statement. The associations have not done half enough to promote scientific practices and policies. Such activities for lumber associations fall well within the proper scope of trade association law. Reasonable regulations of trade, as opposed to restraint of trade, is not forbidden by the Sherman Act. The process of voluntary self-regulation of industry is supported by the views and former activities of the President, by the new philosophy of American business, and by the courts. The various governmental agencies, acting within and under the law, give the most enthusiastic support to voluntary agreements regulating wasteful and unfair trade practices which are intended to conserve resources, to lower or even to stabilize prices, or to contribute to the efficiency of industry.

While we are on the subject of trade association law I would like to quote from Mr. Justice Stone's opinion in the Maple Flooring Case:

"It is the consensus of opinion of economists and of many of the most important agencies of government that the public interest is served by the gathering and dissemination, in the widest possible manner, of information with respect to the production and distribution, cost and prices in actual sales, of market commodities, because the making available of such information tends to stabilize trade and industry, to produce fairer price levels, and to avoid the waste which inevitably attends the unintelligent conduct of economic enterprise. . . . Competition does not become less free merely because the conduct of commercial operations becomes more intelligent through the free distribution of knowledge of all the essential factors entering into the commercial transaction. . . .

"It was not the purpose or the intent of the Sherman Anti-Trust Law to inhibit the intelligent conduct of business operations, nor do we conceive that its purpose was to suppress such influences as might affect the operations of interstate commerce through the application to them of the individual intelligence of those engaged in commerce, enlightened by accurate information as to the essential elements of the economics of a trade or business, however gathered or disseminated."

There is some opposition to increased export of lumber products. I hope Major Ahern will forgive me if I criticize this attitude. In my opinion, it is shortsighted. Lumbermen are in business to make money, and a plan to conserve by stifling trade fails to credit the fact that conservation by mere non-sale and non-use is unprogressive and impossible. What is needed is comprehensive and scientific reforestation, based on the needs of the country, combined with efficient methods of cutting, sawing, and distribution The industry cannot be extinguished; it must be reformed.

In conclusion, though there are some legal and political obstacles, I look with a great deal of hope toward a successful use of the state-compact idea in the petroleum industry, for it may prove to offer an immediately available solution of your problem as lumbermen and foresters.

Meanwhile, I trust you will continue in your efforts to secure coöperation of all interested agencies, to the end that standing forests may be economically exploited and developed, and that timber-growing land may be scientifically planted and developed, pursuant to a uniform and practical plan.

In this effort you must not overlook the force of publicity. I should counsel you to continue to apply yourselves unrelentingly to the business of public instruction on this subject.

SUMMARY OF FIRST YEAR'S HARDWOOD INVESTIGATIONS IN LOUISIANA

By G. H. LENTZ

Special Investigator, Louisiana Division of Forestry and U. S. Forest Service, Coöperating

Hardwood Production in Louisiana

LOUISIANA at present is the leading producer of hardwoods in the United States. In 1926, 790,000,000 board feet, or over 12 per cent of the total hardwood lumber cut in the United States, was produced in this state. The cut in 1927 was even greater. With the decreasing supply of hardwoods in other states this percentage will no doubt be higher in the next five years. Just what will happen after that time it is hard to say.

In commenting on the hardwoods of the Mississippi Valley the Capper report of 1920 (Senate Resolution 311) states: "It is on these alluvial soils that the heaviest and finest stands of hardwoods remain, particularly oak, red gum, ash, and cottonwood, which in 1918 made up more than 50 per cent of the reported cut of hardwoods for the entire country. The extent to which it is drawing on its forest capital is of great importance, because it is the source of our largest remaining hardwood supply."

Exploitation of the hardwoods of Louisiana has reached a point where practically all of the large tracts are either in the hands of sawmill operators who are cutting the timber or are held for speculation by northern capitalists with the idea of cutting them when market conditions improve or when the timber can be sold at a profit. Very few tracts are being held for future growth.

Various estimates have been made as to the time when the virgin hardwood timber will be gone. In the Capper report the statement was made that more and more mills were moving into Mississippi and Louisiana where new plants could be erected with reasonable prospects of a 20 to 25 years' supply of material. An estimate made in 1925 indicated that there was at that time a 30 years' supply of red gum in sight. Few if any of these statements have been based on an accurate study of existing conditions.

Many of the mills that were running in 1923 had closed down by 1928, although in some cases others had taken their place. The most recent development in the hardwood industry in Louisiana is the amalgamation of several small operations under one name. While practically all of the virgin stands of hardwood in Louisiana may be cut out in another few years, it is difficult to estimate the effect this will have on the total production of hardwood. One of the outstanding facts brought out in a study made during 1928 of conditions in the hardwoods of Louisiana was the extent to which second-growth stands were being cut. Second-growth and old-field stands are supplying an increasingly large percentage of the total cut of hardwood in the state.

The hardwoods in Louisiana are found in three general locations or sites:

1. The wide bottoms of the large rivers such as the Mississippi, Atchafalaya, Ouachita, and Red.

2. The narrower bottoms of the smaller streams and rivers flowing through pine lands.

3. The uplands of southeast Louisiana.

Approximately 30 per cent of the total land area of the state is included within the alluvial or bottomland region. Nineteen parishes and portions of 14 others lie within the boundaries of this region.

During 1928 there were about 80 mills, each with a daily output of 30,000 board feet or more, operating in the hardwood region of Louisiana. In the course of the preliminary survey conducted in 1928, 60 mills were visited and information was obtained concerning their timber supply. It was found that 5 mills have a 10 to 15 years' supply; 6 mills have a 5 to 10 years' supply; 32 mills have a 1 to 5 years' supply; and 17 mills own no timberland but operate on logs bought in the vicinity of their mills. Undoubtedly some of the mills will continue to run on purchased logs after their own timber supplies have been exhausted. Indications, however, point to a general trend downward in merchantable hardwood timber supplies.

In a summary of a recent survey by the Hardwood Manufacturers Institute of hardwood mills in operation January 1, 1929, 83 mills were listed for Louisiana, with an estimated total annual production of 908 million board feet. Thirty of these mills expected to cut out within the next 5 years. The survey also showed that during the past 5 years 37 mills had cut out and 21 new mills had come into production in Louisiana.

The preliminary survey of hardwoods in Louisiana which is discussed in this paper covered most of the bottomland region in the state. Eighty-five separate areas were rather intensively studied in order to obtain detailed information as to the composition of typical stands, injury from fire, flood damage, etc. For purposes of this study the hardwood region was divided into six districts and separate reports have been prepared for each. These reports give in detail the forest types found, a description of the various soils, the present ownership of large areas of forest land, a list of the mills operating with their capacity and estimated length of operation, and the extent to which forestry measures are being practiced.

Under proper management the forest land in this region could produce larger yields of wood per acre than possibly any other region in the United States. The soils are exceedingly fertile, the growing season especially long, and weather conditions favorable; all that is lacking is the application of forestry methods on a large scale. Demand for hardwoods should increase as the supply becomes shorter, and the Mississippi bottomlands seem to be the logical place to grow them.

It is true that much of this bottomland region is potential farm land, but at present there is no general demand for cut-over hardwood lands for this purpose. This shows up in the fact that the total area under cultivation has shown a marked decrease in the last 10 years. During this period agricultural practices have changed; by more intensive farming methods the smaller area yields as much as was formerly obtained from larger areas. This trend still continues and very little new land is being cleared for cultivation. Cut-over hardwood lands are not in demand and large areas of cleared land are found lying idle. Extensive areas remain uncultivated due to lack of drain-

age, and the costs of artificial drainage are such that most of these lands will not be reclaimed for many years. Timber crops, however, can be produced on such lands without drainage. In order to keep these lands productive they should be given over to timber growing.

The preliminary survey to which reference has been made was carried on as a coöperative project by the Division of Forestry of the Louisiana Department of Conservation and the Southern Forest Experiment Station. G. H. Lentz, special investigator for the Division of Forestry, was in charge of the work and the services of an assistant, J. A. Putnam, were provided by the Experiment Station. Active field work began in January, 1928, and continued with slight interruption until the following October, after which the field notes were written up in the office.

Before active field work was undertaken, a review of the literature brought out the fact that very little information concerning the southern hardwoods was available, either for Louisiana or adjacent states. Nothing definite could be found as to descriptions and extent of forest types, logging practices, conditions of the hardwood stands, rate at which virgin timber is being cut, occurrence of fires, and prospects for the future of the industry. All of these points were investigated during the course of this preliminary survey and every bottomland hardwood region in Louisiana was visited. Special efforts were made to study second-growth stands in particular and to determine the effect of former fires in the hardwood types. Current logging practices were observed on 20 individual operations, and the degree of utilization in both woods and mill was carefully noted. Eighty-four typical areas were selected for intensive study and strip surveys were run to obtain accurate information on the composition and condition of various types of stands.

Hardwood Habitats and Species

In discussing the distribution of tree species, the bottomlands of the state have been separated into two divisions—those in northeastern Louisiana north of the Red River, and those in southern Louisiana south of the Red River.

For convenience the dominant or merchantable species and those of less commercial importance are listed separately for each habitat, a description of which is deemed essential. Several of the habitats found in the northeastern portion of the state occur also in the southern portion but the composition of the respective stands may differ considerably. For instance, the northern swamps usually contain a variety of hardwoods, while the swamps south of the Red River generally contain only cypress and tupelo gum.

The following estimates indicate the relative proportions represented by each of these habitats in the two main divisions of the bottomland hardwood region in Louisiana:

Northeastern Louisiana

Habitat	Estimated per cent of area
Flat (well drained)	30
Low Ridge (subject to overflow, otherwise well drained)	14
Flat (poorly drained)	12
High Ridge (well drained)	10
Old Field (3 types)	10
River Margin (well drained)	10
Flat (very poorly drained)	8
Swamp(poorly drained)	4
Brake (poorly drained)	2

Southern Louisiana

Habitat	Estimated per cent of area
Flat (poorly drained)	25
Flat (well drained)	20
Swamp (very poorly drained)	18
Ridge and Bluff Land (well drained)	16
Old Field (well drained)	12
River Margin (well drained)	4
Hammock (fairly well drained)	2
Slough (poorly drained)	2
Border of Tidal Marshes (well drained)	1

A brief description of each habitat follows:

Flat. In each region the flat bottomland which is subject to occasional but heavy overflow can be divided into three categories on a basis of drainage. The *well-drained flats* are those with a clay or silt loam soil where rain water seldom stands for any length of time. Such conditions are found on the slightly higher lands usually found nearest the larger water courses. The *very poorly drained flats* are those lying at a lower elevation where the drainage is so poor that it may take weeks in some cases for the rain water to disappear. During the rainy season these areas are often under water for periods of several weeks. The soil is usually a heavy clay which is impervious and prevents seepage. Between these two extremes is the *poorly drained flat.*

Low Ridge. Scattered through the flats are low ridges occasionally as much as five feet above the general elevation. In many cases these ridges are hardly noticeable. They are subject to overflow during heavy floods but are otherwise well drained. After heavy rains these ridges soon dry off. The ridge soil may be either clay or silt loam.

High Ridge. The high ridges are above the overflow level and are seldom inundated even during extreme floods. The soils on these ridges are usually silt loams, in many cases of wind-blown or loess material. The *ridge* sites in southern Louisiana are commonly low ridges but for convenience have been termed merely ridges.

Swamp. The swamps are under water the greater part of the year, occupying the low interior lands that have little or no drainage. During years of extreme drought, such as occurred in 1924, the swamps may dry out, but in other years they are normally full of water. Hardwoods are found in the swamps in the northern part of the state and cypress and tupelo in similar locations in the southern part of the state.

Brake. Brakes are low depressions in which water stands for years at a time and in which no definite drainage has been developed. They are found chiefly in the northeastern parishes where they may be from one to 1,000 acres in extent. The soil is either clay or heavy muck. This habitat may be likened to the spruce bogs found in the northern states.

Hammock. Hammocks are found on sites above overflow but otherwise similar to the flats. They are fairly well drained. In most cases they are found near the margin between the bottomland and the pine uplands. In certain localities such situations are called bays.

Slough. Sloughs occur at the base of the uplands where seepage finds its way into the bottomland. A sluggish stream or bayou usually occurs here, but the drainage is generally poor and water covers a wide area. Tupelo and cypress occur in these sloughs, tupelo in the deeper water, and cypress in the shallower.

River Margin. Fine sand or silt loams are found along the larger rivers and

especially on the "batture" lands between the levees and the rivers. Such lands are subject to overflow during the high water stages of the rivers. Light-seeded species, cottonwood and willow, come in on such lands.

Old Fields. Throughout the bottomland there are areas which at one time were under cultivation but have been abandoned and have come up in hardwood. In many cases even-aged stands are found on these sites, the stands differing from those on the other sites.

Border of Tidal Marshes. In the parishes bordering the Gulf of Mexico there are vast stretches of tidal marsh covered with sedges and other typical marsh vegetation. Bordering these marshes are slightly higher lands supporting stands of live oak and other hardwoods. This live oak association appears to be the first to become established on these lands.

The accompanying tables list the various habitats and the trees commonly found there. The species most frequently found in the bottomland region, in the order of their present commercial importance and estimated extent of occurrence, are as follows:

Northeastern Louisiana

- Red gum (*Liquidambar styraciflua*)
- Black oak (*Quercus nigra*)
- Swamp red oak (*Quercus rubra* var. *pagodaefolia*)
- White and Post oaks (*Quercus alba* and *Q. stellata*)
- Willow oak (*Quercus phellos*)
- Shumard oak (*Quercus shumardii*)
- White ash (*Fraxinus americana*)
- Cottonwood (*Populus deltoides*)
- Red oak (*Quercus rubra*)
- Overcup oak (*Quercus lyrata*)
- Elms (*Ulmus* spp.)
- Cow oak (*Quercus prinus*)
- Cypress (*Taxodium distichum*)
- Pecan (*Hicoria pecan*)
- Sycamore (*Platanus occidentalis*)
- Black gum (*Nyssa sylvatica*)

Southern Louisiana

- Red gum (*Liquidambar styraciflua*)
- Cypress (*Taxodium distichum*)
- Black oak (*Quercus nigra*)
- Shumard oak (*Quercus shumardii*)
- Cow oak (*Quercus prinus*)
- Tupelo gum (*Nyssa aquatica*)
- Magnolia (*Magnolia grandiflora*)
- Swamp red oak (*Quercus rubra* var. *pagodaefolia*)
- Willow oak (*Quercus phellos*)
- Cottonwood (*Populus deltoides*)
- Elm (*Ulmus americana*)
- Tulip poplar (*Liriodendron tulipifera*)
- White oak (*Quercus alba*)
- Water oak (*Quercus obtusa*)
- Hickories (*Hicoria* spp.)
- Black gum (*Nyssa sylvatica*)
- Pecan (*Hicoria pecan*)
- Beech (*Fagus grandiflora*)
- Sycamore (*Platanus occidentalis*)
- White ash (*Fraxinus americana*)
- Willow (*Salix nigra*)

Extent and Severity of Fire Damage

One of the outstanding facts brought out in this study was the extent and severity of fire damage in the bottomland region. The generally expressed opinion has been that fires here have been of little consequence, of infrequent occurrence, and, because of the moist nature of the site, did little damage. It was found, however, that fires had been the cause of very considerable losses in the hardwoods, possibly greater even than

TABLE I

DISTRIBUTION OF TREES IN THE HARDWOOD BOTTOMLANDS OF NORTHEASTERN LOUISIANA ACCORDING TO HABITAT

Habitat	Dominant Species	Associated Dominants	Minor Species
Flat (well drained).......	Black oak (*Quercus nigra*)..............	Red oak (*Quercus rubra*) Willow oak (*Q. phellos*) Overcup oak (*Q. lyrata*) Red gum (*Liquidambar styraciflua*)	White ash (*Fraxinus americana*) White elm (*Ulmus americana*) Hackberry (*Celtis laevigata*) Pecan (*Hicoria pecan*)
Flat (poorly drained).....	Red gum (*Liquidambar styraciflua*)........	White ash (*Fraxinus americana*) Willow oak (*Quercus phellos*) Swamp red oak (*Q. rubra* var. *pagodaefolia*)	Persimmon (*Diospyros virginiana*) White elm (*Ulmus americana*) Pecan (*Hicoria pecan*) Hackberry (*Celtis laevigata*) Cypress (*Taxodium distichum*) Hawthorns (*Crataegus* spp.)
Flat (very poorly drained).	Overcup oak (*Quercus lyrata*)...........	Pecan (*Hicoria pecan*)..................	Black oak (*Quercus nigra*) Willow oak (*Q. phellos*) Swamp red oak (*Q. rubra* var. *pagodaefolia*) White ash (*Fraxinus americana*) Persimmon (*Diospyros virginiana*) Bald cypress (*Taxodium distichum*) Red gum (*Liquidambar styraciflua*)
High ridge (above overflow; well drained).	White oak (*Quercus alba*)...............	Hickory (*Hicoria glabra*) Willow oak (*Quercus phellos*) Black oak (*Q. nigra*) Shumard red oak (*Q. shumardii*) Post oak (*Q. stellata*) White ash (*Fraxinus americana*)	Elm (*Ulmus* spp.) Red gum (*Liquidambar styraciflua*) Black gum (*Nyssa sylvatica*) Persimmon (*Diospyros virginiana*) Maple (*Acer rubrum*)
Low ridge (subject to overflow; otherwise well drained).	Red gum (*Liquidambar styraciflua*)........	Black oak (*Quercus nigra*) Willow oak (*Q. phellos*) Swamp red oak (*Q. rubra* var. *pagodaefolia*)	Elms (*Ulmus americana* and *U. alata*) Red maple (*Acer rubrum*) Hackberry (*Celtis laevigata*) Pecan (*Hicoria pecan*) Honey locust (*Gleditsia triacanthos*)
Swamp (very poorly drained).	Non merchantable: Overcup oak (*Quercus lyrata*) Swamp red oak (*Q. rubra* var. *pagodaefolia*) Water hickory (*Hicoria aquatica*)	Red maple (*Acer rubrum*) Hackberry (*Celtis laevigata*) White ash (*Fraxinus americana*) White elm (*Ulmus americana*)	Water oak (*Quercus obtusa*) Planer tree (*Planera aquatica*) Water locust (*Gleditsia aquatica*)
Brake (little or no drainage).	Bald cypress (*Taxodium distichum*)......	Tupelo gum (*Nyssa aquatica*).............	Red maple (*Acer rubrum*)
River margin (well drained).	Cottonwood (*Populus deltoides*)..........	Willow (*Salix nigra*)...................	Sycamore (*Platanus occidentalis*)
Old field (well drained)...	Red gum (*Liquidambar styraciflua*)........	Pure stands or with Cottonwood (*Populus deltoides*).	
Old field (well drained)...	Cottonwood (*Populus deltoides*)...........	Pure stands or with red gum (*Liquidambar styraciflua*).	
Old field (well drained)...	Oak, chiefly black oak (*Quercus nigra*)....	Red gum (*Liquidambar styraciflua*) Red oak (*Quercus rubra*)	White ash (*Fraxinus americana*) White elm (*Ulmus americana*)

TABLE 2

DISTRIBUTION OF TREES IN THE HARDWOOD BOTTOMLANDS OF SOUTHERN LOUISIANA ACCORDING TO HABITAT

Habitat	Dominant Species	Associated Dominants	Minor Species
Flat (well drained)	Black oak (*Quercus nigra*)	Cow oak (*Quercus prinus*) Shumard red oak (*Q. shumardii*)	Red gum (*Liquidambar styraciflua*) White ash (*Fraxinus americana*) Sycamore (*Platanus occidentalis*) Hickory (*Hicoria* spp.) Hackberry (*Celtis laevigata*) Honey locust (*Gleditsia triacanthos*)
Flat (poorly drained)	Red gum (*Liquidambar styraciflua*)	Bald cypress (*Taxodium distichum*) Swamp red oak (*Quercus rubra* var. *pagodaefolia*) White ash (*Fraxinus americana*) White alm (*Ulmus americana*)	Black oak (*Quercus nigra*) Overcup oak (*Q. lyrata*) Hackberry (*Celtis laevigata*) Red maple (*Acer rubrum*) Persimmon (*Diospyros virginiana*)
Ridge (well drained)	Cow oak (*Quercus prinus*)	White ash (*Fraxinus americana*) Red gum (*Liquidambar styraciflua*) Black gum (*Nyssa sylvatica*)	Honey locust (*Gleditsia triacanthos*) White elm (*Ulmus americana*) Sycamore (*Platanus occidentalis*)
River margin (well drained)	Cottonwood (*Populus deltoides*)	Willow (*Salix nigra*) Sycamore (*Platanus occidentalis*)	Hackberry (*Celtis laevigata*) Bald cypress (*Taxodium distichum*) Roughleaf dogwood (*Cornus asperifolia*)
Hammock (fairly well drained).	Red gum (*Liquidambar styraciflua*)	Red gum (*Liquidambar styraciflua*) Magnolia (*Magnolia grandiflora*) White oak (*Quercus alba*) Black oak (*Q. nigra*) Shumard oak (*Q. shumardii*) Cow oak (*Q. prinus*) Hickory (*Hicoria glabra*) White ash (*Fraxinus americana*) Yellow poplar (*Liriodendron tulipifera*)	Black gum (*Nyssa sylvatica*) Basswood (*Tilia americana*) Blue beech (*Carpinus caroliniana*) Rougleaf dogwood (*Cornus asperifolia*) Beech (*Fagus grandiflora*)
Swamp (very poorly drained).	Bald cypress (*Taxodium distichum*)	Tupelo gum (*Nyssa aquatica*)	White ash (*Fraxinus americana*) Red maple (*Acer rubrum*) Planer tree (*Planera aquatica*) Willow (*Salix nigra*)
Slough (poorly drained)	Tupelo gum (*Nyssa aquatica*)	Bald cypress (*Taxodium distichum*)	White elm (*Ulmus americana*) Willow (*Salix nigra*) Red maple (*Acer rubrum*) Hackberry (*Celtis laevigata*)
Border of tidal marshes (well drained).	Live oak (*Quercus virginiana*)	Black oak (*Quercus nigra*) Laurel oak (*Q. laurifolia*) Red gum (*Liquidambar styraciflua*) Magnolia (*Magnolia grandiflora*)	White ash (*Fraxinus americana*) White elm (*Ulmus americana*) Pecan (*Hicoria pecan*) Holly (*Ilex opaca*)
Old field (well drained)	Red gum (*Liquidambar styraciflua*)	Pure stands or with black oak (*Quercus nigra*) and elm (*Ulmus americana*)	
Old field (well drained)	Black oak (*Quercus nigra*)	Willow oak (*Quercus phellos*) Red oak (*Q. rubra*) Water oak (*Q. obtusa*)	White elm (*Ulmus americana*) Hackberry (*Celtis laevigata*)
Old field (well drained)	Cottonwood (*Populus deltoides*)	Pine stand or with red gum (*Liquidambar styraciflua*)	

similar losses in the pine region. The initial fire injury may not be as great as in the pines, but the decay caused by fungi which gain entrance through fire scars is a very considerable factor.

In the bottomlands north of the Red River, 80 to 90 per cent or more of the hardwood stands were found to have burned over in 1916, in 1924-25, or during both these periods. Evidences of fire as far back as 1860 or thereabouts were also noted. The damage from fire was not so pronounced in the parishes south of the Red River and those east of the Mississippi River but some fire injury was also evident there. A detailed study on a logging operation in a red gum flat where fires had occurred in 1916 and again in 1924 showed that the loss in merchantable timber due to fire and decay amounted to about 15 per cent of the stand. This was not an exceptional case and similar losses have occurred in other parts of the hardwood region.

Damage to Reproduction by High Water

In localities where the flood waters of 1927 covered young trees for a period of a month or more nearly all of the young growth was killed. Willow and cottonwood seemed to be able to withstand flooding but other species such as ash, red gum, oak, and pecan were killed when submerged for a month or longer. This condition was found in all portions of the bottomlands where overflows occurred. The flood waters in some cases reached a height of 20 feet and trees up to that height as well as some of those two to four feet taller and as large as three inches in diameter were killed. Trees of this size were ordinarily 6 to 10 years old. If the proposed flood control measures are carried into effect, loss of hardwood reproduction in the spill basin area may be anticipated during those years in which the control measures have to be applied.

Growth and Yields

From data collected on 20 separate plots for different types the growth per acre per year was calculated. This showed wide variations, and from the limited number of plots studied it would be unwise to try to draw an average growth figure, especially as the plots were not fully stocked nor had they received any special attention from the owners. Under forest management it should be possible to increase the annual growth considerably. On the rich alluvial soils and under intensive management an annual growth of 500 board feet per acre per year should be possible.

Forestry Methods Seldom Applied in Hardwood Operations

Less than five per cent of the hardwood operators have taken any steps toward applying any forestry methods to their logging operations. In the past the general policy, if it can be termed such, was to clear cut and then sell the land for farming purposes. Some of the companies opened land offices and made determined efforts to dispose of their cut-over lands to prospective farmers. Within the past five years it has been practically impossible to dispose of cut-over hardwood lands in this way. The discovery of oil and gas in some districts has influenced the timberland owners to retain ownership in their cut-over areas, but few have held such lands for the pur-

pose of producing another crop of timber.

In the pine region clear cutting followed by fire has in many cases resulted in such devastation that a new growth of timber trees can be obtained only by artificial reforestation. However, no devastated areas of this sort occur in the hardwood bottomlands. Hardwood reproduction comes back even on areas that have received the most severe treatment. With light seeds easily scattered by the wind and with an extremely fertile soil these areas are certain to revert to forests. Under present conditions, however, the growth of a second crop is a long, tedious process and it is practically impossible to produce a good stand of timber in this way. Cut-over areas are too often left with little or no growing stock or with inferior species monopolizing the site.

Under the usual cutting methods all trees above a fixed diameter limit are cut. Many of the smaller trees cut under this practice may have just reached the stage where they are putting on clear growth. Such trees might better be left for a future cut, and, with increased light and food material because of the removal of competition, they would rapidly increase in value. In 10 to 20 years they might easily be worth 5 to 10 times their value at the time the initial cutting was made.

The system whereby only the best trees of the most desirable species are removed is much more to be condemned than is clear-cutting of the older stands. Under the former method only the malformed and misshapen specimens or undesirable species are left. Their crowns intercept light, their root systems occupy the soil, and they prevent the development of more valuable young stands.

A few far-sighted timberland owners have realized that it is unprofitable to cut their small trees and are now cutting their holdings under a selection system. Only the mature trees are taken, leaving the younger ones for a future cut when they will be considerably larger and contain a greater proportion of the higher grades of lumber. By applying this method these progressive operators are keeping their forest lands productive; they get a better grade of logs for their mills, and, with a sufficient area to draw upon, they can obtain a supply of raw material to run their mills indefinitely.

This preliminary study points to the need for further investigations in the southern hardwood region. Not only should similar surveys be made in the important hardwood districts in the southern states, but detailed studies of logging costs, growth and methods of cutting are all important as a means of interesting timberland owners in the possibility of practicing forestry on their lands.

A STUDY OF DAMAGE BY TRACTOR SKIDDING

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THE INFLUENCE of tractors used in skidding operations on the future forest was studied in August, 1928, on the Cady Lumber Corporation sale, Sitgreaves National Forest, Arizona. The investigation was undertaken primarily to determine the extent of damage done to advance reproduction by skidding the logs direct to the landing with tractors in comparison with the damage done in logging with horses and big wheels. While the study has not progressed far enough to enable one to draw conclusions as to the comparative damage, the analysis of the tractor study data should prove of interest to foresters.

History of Tractor Logging in the Southwest

Tractor logging started in the Southwestern District in 1925, and has developed to such an extent that tractors are now used in some phase of the logging in every large operation in the Southwest. The use of tractors in skidding was allowed on national forest sales with the understanding that regulations governing their operation would be drawn up on the basis of study and experience which would minimize the damage to the reserve stand and advance growth just as similar regulations have been developed in connection with steam skidding. Studies made in the California District were drawn upon largely in developing these restrictions, but considerable first-hand information was secured by a number of timber sale men working independently. The following instructions are a result of the study made:

INSTRUCTIONS TO FELLERS AND BUCKERS

1. Do not cut stumps higher than 14 inches on the uphill side.
2. Buck all trees to a diameter of 8 inches in the top when merchantable.
3. Allow 4 inches trimming allowance on logs 12 to 16 feet in length; 8 inches on logs 18 to 32 feet; and 12 inches above 32 feet.
4. Plan felling on each area a few hundred feet ahead of where you are working so that timber can be felled with the least damage to young growth and with the least breakage of sound material.
5. Fell timber into openings so as to miss groups of young growth larger than 5 feet in height unless this instruction is changed for any specific area by the man in charge of felling.
6. Fell timber so that no damage will be done to trees or poles.
7. Fellers will place their numbers, or other distinguishing marks, on the stumps of all trees which they fell.

INSTRUCTIONS TO "CAT" DRIVERS AND CHOKER SETTERS

1. No swamping or cutting of young tree growth to clear the ground

for skidding shall be done except at the landings.

2. Make as few roads as possible and do not cut across from one to another either empty or loaded.

3. Do not drive a tractor or make roads through groups of reproduction over 5 feet in height where it can be avoided.

4. Do not siwash logs around trees, poles, or groups of young trees over 5 feet in height, and make tractor road as straight as possible to landing unless this would cause more damage than going around reproduction over 5 feet in height.

9. Extra chokers should be provided so that the tractor driver need not make a wide swing at the log to prevent fouling the chokers.

10. A yarding line or double choker should be used to get a log out of thick young growth.

11. Unless a log lies in an opening it should be pulled endwise from its bed.

12. Do not overload tractors. When a load is too heavy either drop part of it or obtain help from another driver.

These restrictions were in force at the time the study was made.

TABLE 1

NUMBER OF TREES 12 INCHES OR OVER IN DIAMETER BREAST HIGH AND VOLUME IN BOARD FEET PER ACRE BEFORE AND AFTER CUTTING

Kind of tree	No. of trees			Net volume			Per cent of total vol. cut	No. seed trees over 20" in diameter left	Per cent deducted for defect	
	Cut	Left	Total	Cut	Left	Total			Marked timber	Retained timber
Yellow Pine..	13.8	1.9	15.7	8950	1270	10220	87	1.4	17	10
Black Jack...	7.6	10.5	18.1	1350	2250	3600	38	2.4	10	5
Total ...	21.4	12.4	33.8	10300	3520	13820	74.5	3.8	..	..

5. The choker setter should let the tractor driver know where he will get the next load to prevent unnecessary driving across country.

6. Do not hook two logs at the same cut and swing them out sidewise unless the logs are in an opening and this action will cause less damage than through pulling out each log separately.

7. Do not pull a log across young growth to hook another log.

8. Short chokers should be used so far as possible. A few long chokers should be kept at the landing and taken to the woods when necessary to skid large logs.

THE STUDY

A ten-acre plot in a pure western yellow pine stand was laid out with compass and chain and gridironed by setting stakes at one chain intervals throughout the plot. The plot was then marked for cutting, following the District 3 standard marking instructions. Table 1 shows the result of the marking.

A detailed map was prepared showing the location of marked trees, retained trees, large and small poles, and reproduction in four classes, viz., massed saplings, massed seedlings, scattered seedlings (but sufficiently dense to come

within the District 3 working standard of satisfactory stocking, which is 2 or more seedlings per mil-acre plot), and isolated individual saplings or seedlings. A summary of reproduction conditions is presented in the following tabulation:

	Per cent of entire area
Massed saplings	8.75
Massed seedlings	23.00
Scattered seedlings	43.25
Total fully stocked	75.00

mens which are injured to such a small extent that they will probably recover. If seriously damaged they were counted in the destroyed class.

It was realized that the total number of individuals per acre is not a true measure of satisfactory stocking. Therefore, a strip reproduction survey was run along each line of the plot at right angles to the skid trails before and after logging. The exact status as to stocking was recorded for 1100 mil-acre plots, or

TABLE 2

NUMBER OF POLES, SAPLINGS, AND SEEDLINGS PER ACRE BEFORE AND AFTER LOGGING ON TWO HALF-ACRE PLOTS

Class of reproduction	Before logging	After logging			
		Uninjured	Injured	Total left	Destroyed
Poles, 8″ to 11″	10	10	..	10	..
Poles, 4″ to 7″	4	4	..	4	..
Saplings	293	259	12	271	22
Seedlings	4444	2579	438	3017	1427
Total	4751	2852	450	3302	1449

A count of seedlings, saplings, and poles was made before and after logging on two half-acre strips across the plot. Table 2 shows the results of this count, and indicates a reduction of 30.5 per cent in the total amount of reproduction. The injured class includes those speci-

for 11 per cent of the area, as shown in Table 3.

The plots were recorded without regard to the presence of trees of the reserve stand above 12 inches in diameter. If these be added, the stocking of the area as a whole will be increased 4.4 per cent.

TABLE 3

RESULT OF A STRIP SURVEY AT ONE CHAIN INTERVALS BEFORE AND AFTER LOGGING, BY MIL-ACRE PLOTS

Stocking	No. of plots		Reduced to full stocking equivalent		Per cent of entire strip fully stocked	
	Before	After	Before	After	Before	After
Fully stocked with poles	12	12	12	12	1.1	1.1
Fully stocked with saplings	88	80	88	80	8.0	7.3
Fully stocked with seedlings	676	534	676	534	61.4	48.6
Half stocked with seedlings	112	102	56	51	5.1	4.6
Blanks	212	374	...	...	...	....
Total	1100	1100	832	675	75.6	61.6

NOTE.—A pole may stock one or more plots depending on its size and location; 1 sapling per plot or two established seedlings (*i. e.*, from 0.5′ to 6′) is considered full stocking. One established seedling in a plot is considered half stocking.

After logging, the area was again mapped to show tractor trails on which all reproduction was totally destroyed, and area covered by the tractor where the reproduction was damaged or simply thinned, with the following results:

	Per cent of total area
Area covered by tractor trails...	14.25
Additional area injured by tractor	31.00
Area not touched.............	54.75
Total	100.00

The tractor trails upon which all reproduction was totally destroyed cover 14.25 per cent of the area of the plot. However, approximately 4.1 per cent of the trail area is on open ground since tractor trails were confined to open areas so far as possible. Tractor trails are nevertheless responsible for a very large part of the damage, while getting logs to these trails operated mainly as a thinning of the stand.

Turning the tractor around in reproduction patches causes more damage than simply passing over the patch straight ahead or backwards.

It was observed that hooking two logs at the same cut and pulling them out sidewise results in but little damage to seedlings less than 2 feet high. The smaller seedlings are simply bent over and soon straighten up. Larger seedlings and saplings are either broken off or are so severely barked as to be permanently injured.

Before this study was undertaken, it was agreed with the woods superintendent that the plot would be logged in the same manner followed on the operation as a whole. While the restrictions were not closely followed, particularly as to the use of a yarding line in getting logs out of thick young growth or in hooking two logs at the same cut, still on the whole it was apparent that a little more care was exercised on the plot than on the operation as a whole. This was probably to be expected. As a check on this two miles of reproduction strips were run on a half section of cut-over land which was believed to have been more or less comparable to the plot before logging. This check showed the half section of cut-over area to be 47 per cent stocked. Railroad rights-of-way and landings where practically all growth had been cut and destroyed were estimated at 10 per cent of the total area. Taking this into consideration, the stocking of this cut-over area is a little less than the stocking on the plot after logging.

Conclusions

1. Direct skidding of logs (usually in double lengths) from the stumps to the landing by caterpillar tractors can be done with a minimum of damage to advance growth, provided the restrictions already developed are adhered to.

2. Adherence to the requirement that a yarding line or double choker be used to pull logs out of dense reproduction will reduce the damage materially.

3. Hooking two logs at the same cut should only be allowed in openings or where the reproduction does not exceed 2 feet in height.

4. Turning in openings and backing to the log results in less damage to reproduction than turning at the log.

5. The greatest possibility in further reducing damage lies in the careful layout of skid trails prior to felling to reduce the area covered by these trails to a minimum. So far as possible the logs should be pointed to or from the skid trails.

6. Further study should be made to determine the economic effect of further refined restrictions on the skidding operation, especially in comparison with the value of the reproduction saved by the refinement of the operation.

DAMAGE TO WESTERN YELLOW PINE REPRODUCTION UNDER VARIOUS LOGGING METHODS

By WALTER J. PERRY

Lumberman, Deschutes National Forest

THE IMPORTANCE of conserving existing reproduction in western yellow pine logging operations has long been stressed by foresters. At times we have verged upon impracticable extremes in this respect; at others we have allowed destructive methods because those methods had proven satisfactory under a widely different set of conditions elsewhere. There was not much exact information as to relative damage under different logging methods and usually we were guided, at best, by the boiled-down results of more or less general observations, with perhaps not enough weight given to local conditions in the individual case. The objective was right, however far we may have missed it at times in our results, or how imperfectly we understood the underlying reasons.

The General Situation

It *is* important silviculturally that reproduction survive logging operations in the western yellow pine stands. A superficially plausible argument may be made, and frequently is made by logging interests, that (1) destruction of reproduction, particularly in the seedling stage, constitutes little if any loss to the forest, as subsequent seedlings coming in in the openings without competition will outstrip the surviving "stunted pig" seedlings that have been watchfully waiting for an opening for several years; and (2) that the tearing up of the forest floor creates an ideal condition for the natural planting and germination of seed. Neither of these shots is far from the mark, and on the face of it the argument seems good—but there is something on the other side of the picture.

It is, I believe, true that much the greater number of pine seed cast, even if not molested, never reach that depth in undisturbed duff where the material is sufficiently compact to hold the requisite moisture for germination, and that harrowing up the duff and soil by any means tends to create a condition favorable to restocking by permitting ready access to mineral soil. That seedlings do come in more readily on old grades, skid roads, etc., is a matter of common observation. Also, it is true that many of the existing seedlings are "stunted pigs," and that it will take them perhaps three or four years to really get under way, but they are already there and have roots in the ground deep enough to carry them over a dry season so often fatal to a tender, new seedling. Moreover, and not less important, the germination of new seedlings after logging is problematical, and complete stocking at best a long-drawn-out operation. That has been our experience on tens of thousands of acres where theoretically sufficient seed trees had been left at time of cutting.

It sometimes happens that on some particular area western yellow pine re-

production springs up plentifully the first season after logging. When this happens much capital is made of it and we are urged to travel miles (across non-reproduced area!) to look at this concrete proof of the advantages of thoroughly tearing up the ground in the process of logging. It is a very significant fact, however, that this may occur on *clear-cut* land as well as where seed trees were left. What happened was that logging was being carried on while the seed crop was being cast and many seed were dragged or trampled into the ground. If a general seed crop occurs once in five years, and the planting-by-logging process continues for one month, then the chances are as 1 to 60 that the ground will be restocked in this manner. A rather slim chance!

When natural reproduction is lacking, or is destroyed in logging, we must depend upon subsequent reproduction. But seed is a prerequisite to subsequent restocking under any condition, and the fact that an undiminished population of seed-consuming rodents and birds concentrating on their much diminished food supply much more than counterbalances the more receptive condition of the soil after logging has not apparently been sufficiently convincing as yet. We therefore continue to remove a heavy weight from one side of the balance only and, when the other side hits the floor, assume a look of perplexed surprise and disappointment. Until this lesson is learned and remedial measures are put into practice, it is doubly important that we do all that is possible, or practicable, to conserve existing reproduction, even though this should render necessary some concessions on stumpage values to cover the cost of special, or perhaps antiquated, logging methods.

The Trend in Logging Methods

The use of heavy caterpillar tractors is becoming very general by large and progressive operators wherever in the western yellow pine belt the topography will permit of their use; commonly with high-wheels on gentle slopes, and for direct skidding on steeper country. The "cats" are efficient—they get the logs. They have come to stay. Also, on soft ground, and to reproduction under pole size, they are the most destructive equipment yet devised when used for direct skidding or for wheeling bunched logs. However, when used with high-wheels and skidding-drum attachment, they are capable of a logging job less destructive to young growth than any we have tried, and with no damage to large-sized reserve trees. This was clearly brought out in a comparative damage study made on the Deschutes National Forest in central Oregon.

Sample Plot Logging Study

In an effort to determine actual amount of logging damage, by measure and count, under different logging methods, four plots of 10 acres each were established and each logged by a different method. Conditions as to topography and soil moisture were not identical on the different plots. However, it is believed that plots 2, 3, and 4 were nearly enough so to furnish a fair comparison, and that approximately the same ratio of damage as between methods would obtain under any set of conditions. The plots were located so as to represent average damage as nearly as might be.

Plots were laid off into 100 blocks, 1-chain square, by compass and chain. From the centers of these all mapping

and platting was done while two assistants counted reproduction, calipered trees, etc. Each plot was gone over before cutting started and after logging was completed. In one case, Tractor Plot 1, an intermediate examination was made to segregate damage resulting from swamping and bunching only. In the accompanying table this damage is combined with skidding and wheeling damage. Very detailed maps on a scale of 2½ inches to the chain were prepared for each plot, showing all skid trails, stumps, reserved trees, poles and individual scattered seedlings, and outlines of "massed" areas. Scattered seedlings were shown as found, only one being counted to any 6-inch plot. Three-foot saplings were given a value of 3 seedlings; a pole 6 seedlings. Land that carried 1280 seedlings or equivalent per acre was considered fully stocked or "massed."

It should be borne in mind that on the volcanic pumice type of soil upon which these experiments were carried out the moisture content of the soil at time of logging has a very important bearing on the amount of damage sustained, and that, directly opposite to what would be the case in adobe or other hard or clayey soil, the drier the soil the more loose and ashy it becomes and consequently the greatest skidding damage occurs under that condition. It is never muddy but when well saturated is in its firmest condition except, of course, when frozen.

The following data and remarks upon surrounding conditions may help toward a clearer understanding:

Plot 1. Best "60" caterpillar and high wheels.
Double length logs (32′)—bunched by horses.
Average slope 18 per cent.
Soil very dry and ashy.
Stand removed, 24,685 board feet per acre.
Reproduction, seedlings to saplings, area 61.3 per cent stocked.

The soil was so dry and loose on this plot that a man might with one hand lift out by the roots a sapling several feet high and one inch in diameter. Owing to logs plowing in the soft soil it was found impossible to skid logs any distance with horses, and even swinging them around to form bunches or loads resulted in moving much surface soil and the destruction of seedlings. Also much swamping damage in larger saplings resulted from cutting cross-hauls when rolling logs from their beds or worrying them into bunches. Due to lack of traction and consequent slipping of tractor treads when pulling a load, or even when running light up hill, practically all seedlings directly under the treads were dug out or loosened the first time over, whereas in firmer soil seedlings are apt to survive being run over once.

This style of rig (60 "cat" with high wheels) requires a 27-foot circle in which to turn. It is necessary to run out to each individual bunch, make this turn, cramp the "cat," and back the wheels over the load. In cramping, or turning, one track simply idles while the other works, and the idle side grinds into the ground. When this process is repeated for every load of 1200 to 1800 feet, the ground is pretty well covered by this veritable juggernaut.

Plot 2. Lidgerwood skidder.
Double length logs (32′)—no bunching.
Land nearly level.
Soil fairly moist.

Stand removed, 21,425 board feet per acre.

Reproduction, mostly seedlings and small saplings; area 66.7 per cent stocked.

The Lidgerwood skidder uses a tight overhead main line between a steel mast on the machine and a guyed spar tree 1200 to 1500 feet distant. A bicycle block carrying the skidding line travels on this. The bicycle may be held at any point on the main line by the lighter haul-back line. In skidding, the bicycle is stopped and held at a point where the least damage will result when the choked logs are hauled in to the main line. This may be opposite to, in front of, or behind the logs to be skidded. The end of the skidding line with returned chokers is lowered from the bicycle and pulled out by hand to the logs where previously set chokers are hooked on and the signal to haul given by wire. Logs are skidded to the main trail, lifted up to make them sooner take the trail, then lowered, and skidded in with rear ends dragging. Main skid trails are about 12 feet wide and destruction is complete on this strip. Any trees of merchantable size under the main line are choked and pulled out by the roots, then skidded in to be bucked into logs near the machine.

The main skid trails radiate from the anding like spokes from a hub, and may e from 175 to 250 feet apart at the arther end, with an average of about oo feet. This distance varies, depending on availability of suitable spar trees. The trails of course converge on the kidder until at the landing the entire round is covered. If laid parallel there vould be a 12-foot trail approximately very 100 to 125 feet. There has, of ourse, been no damage from bunching; neither horses, caterpillars, nor wheels have run over the ground; and the trails are straight and cover a minimum area. Probably no method we know is less damaging to reproduction up to large sapling size. Occasionally it is impossible to remove logs from groups of poles without some damage. All trees on main skid trails are, of course, removed, but if of merchantable size they are bucked and logged.

The slight skidding damage in getting logs to the main line is due to the lifting action which tends to prevent plowing by the logs.

Plot 3. Best "60" caterpillar and high wheels equipped with Willamette skidding drum.

Double length logs (32′)—no bunching.

Land nearly level.

Soil moist.

Stand removed, 12,293 board feet per acre.

Reproduction, largely saplings up to 4 feet diameter; area 98.2 per cent stocked.

This rig is the "Best 60 Cat" with a powerful skidding drum mounted on the rear, from which a ¾-inch line passes over a fairway roller mounted on the axle of the wheels. Main roads average 125 feet apart, but no attempt is made to space them equally; they run through the heaviest bunches of logs, care being taken to avoid clumps of reproduction.

In action, the rig runs out to first logs, turns, and backs up. Two choker setters then pull out the slackened skidding line by hand a maximum distance of 65 feet and hook to previously set chokers. Logs are hauled in between the wheels by the drum and lifted against the axle with

rear ends dragging, in which position they take the trail. The same turning point may be used for several loads, the machine being backed down the trail until another suitable turning point is found, about 100 feet distant. Chokers are set with a rolling hitch so logs will turn over and skid with broken stub branches uppermost and do less plowing.

There appears to be no advantage in felling timber at right angles to the steel or parallel with it. If felled at 45°, converging on the skid road and steel, the minimum of skidding damage would result, but this is impracticable.

Main wheel roads average the same width as Lidgerwood trails, 12 feet, and destruction is usually complete. Damage to reproduction through yarding to the main trail is slight by reason of the lifting action exerted, the fairway roller being some eight feet above the ground. There is, of course, no swamping or bunching damage, and direct skidding damage is less than where horses are used through the absence of trampling and less plowing as the logs are skidded.

Damage by the "cat" with skidding drum attachment is confined almost entirely to material of small pole size or under. Unlike the Lidgerwood it can avoid clumps of reproduction or reserved trees.

When this rig is carefully handled the damage may be somewhat less than that by the Lidgerwood; when not handled with care it may be very much greater, as when main trails are unduly multiplied.

Incidentally, the appearance of this plot seems to improve with age, and it is now, 1½ years after logging, very difficult or even impossible to trace the course of many of the logs from the stump.

Plot 4. Horses and high wheels.

- Short logs (16′)—bunched b horses.
- Land level to slightly rolling.
- Soil dry but less ashy than on oth plots.
- Stand removed, 10,057 board fe per acre.
- Reproduction, seedlings to sma saplings; area 29.3 per cen stocked.

Checked by general observations o much territory logged by this metho under similar soil conditions, and wi approximately the same stumpage r moved per acre, the results on this pl do not appear to present quite a fair pi ture. Due to topography, more timb was wheeled across this area to the ste than would be the case on the averag plot of this size, and the damage w correspondingly somewhat greater. O the other hand, since this study was mad this same outfit has logged a level ar where the ground was very dry and loos This area was exceptionally well repr duced with seedlings and small sapling About 20 thousand feet per acre was r moved and timber was of only mediu size. The combined skidding, bunchin and wheeling damage covered practical the entire area and the loss was extreme heavy. While no detailed study w made of this latter area it is very ce tain that the loss was much greater tha if either the "cat" and drum or th Lidgerwood method had been used.

Under any skidding method, but pa ticularly it seems where bunched lo are moved by ground traction, the dam age will be in proportion to the amou of timber removed; or rather, to be mo exact, in proportion to the number wheel loads removed. Thus the dama

vill be lightest where timber is large ınd maximum loads are put up, for the louble reason that fewer trips are made off the main wheel roads and that sev- eral trips may be made over the same ide road in removing a single tree. Bunching damage also is much less in arge timber as little ground skidding is lone and logs are rolled, or turned on hock blocks, with little disturbance of urface soil.

Table 1.

COMPARATIVE DAMAGE BY DIFFERENT LOGGING METHODS.

Logging Method	Stocking and Survival by Size Classes					
		12″ and up d. b. h.[1]	4″ to 11″ d. b. h.	5′ high to 4″ d. b. h.	2′ to 5′ high	Less than 2′ high
Plot 1 Caterpillar and Wheels (Long logs bunched)	Stand per Acre before logging	39+16	27.7	360	850	1390
	Survival	100%	87%	21.5%	18%	42%
Plot 2 Lidgerwood Skidder (Long logs)	Before logging	28.3+10.5	3.4	279	1488	1953
	Survival	98%	67%	64%	75%	80%
Plot 3 Caterpillar, Wheels and Skidding Drum (Long logs)	Before logging	9.5+6.1	2.7	800	955	2585
	Survival	100%	100%	93%	97%	98%
Plot 4 Horses and Wheels (Short logs bunched)	Before logging	12+5.3	2	20	30	475
	Survival	100%	100%	98%	92%	84%

[1] The first figure in this column opposite "Stand per acre before logging," indicates the number of trees arked for logging, the second figure those not marked for logging. The percentage figure in this and other olumns indicates in each case the percentage of unmarked trees surviving after logging.

In the interest of brevity, the multi- udinous figures and tabulations for the ndividual plots are not reproduced. In- tead only the essential data for each are hown in the accompanying table.

Conclusions

A long series of these experiments arried out on various types of soil might nable us to decide in advance just what method would be best on any given area. In so far as conclusions may be drawn from these few studies, which apply to a certain type of soil only, it may be said that the caterpillar tractor with high wheels and skidding drum gives the best average immediate results, and that such damage as does result is confined largely to reproduction of age classes subject to a high mortality before reaching merchantable size; whereas the damage by Lidgerwood skidder, while in immediate severity very nearly the same, tends to be in the older, better established, and therefore more valuable age classes.

The merits of horse logging have, the writer believes, been much overrated in the past. Certainly on soft soils either of the foregoing methods will give better results when conserving reproduction is the chief consideration.

Lidgerwood skidders should not be used where there is a heavy reserve stand of young trees, or where reproduction runs heavily to poles and large saplings. Under these conditions the caterpillar with wheels and skidding drum will give best results.

The firmer the soil the less damage results, whatever method is used. However, caterpillars with skidding drums would be favored as against Lidgerwoods for the reason that the latter do a certain amount of damage to large stock regardless of the nature of the soil.

The writer concludes, on the basis of these studies supplemented by much personal observation, that best results would be obtained by entirely eliminating bunching, cutting timber in double log lengths (32′), and removing these logs by the Cat-Wheels-Drum method. The Lidgerwood would be second choi where the nature of the reserve sta and reproduction would permit its u

It must be remembered that the logg is out after logs, and that he is mo or less impatient under any restrictio which tend to reduce his output. A re sonably careful Lidgerwood crew do about so much unavoidable damage gardless of any increased supervisio On the other hand, the caterpillar ope ator may hold to his main roads, ha his skidding line pulled out, and l with a minimum of damage; or he ma if not given close supervision, take sho cuts, run out to his logs instead of ser ing out the line, and do as much dama as if no skidding drum existed. Hen the necessity of more constant and tailed supervision when this method used.

POSSIBILITIES OF ECONOMIC TRANSPORTATION OF NORTHEASTERN HARDWOODS

By BERNARD FRANK

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IN HIS article, "The Hardwood Problem of the Northeast" (JOURNAL OF FORESTRY, November, 1928), Austin Cary dismisses at once the possibilities of utilizing the hardwoods on softwood lands by assuming, first, that they are not adapted to water transportation, and second, that any other means of transport would entail excessive cost. No one, I believe, will take issue with the latter assumption; the construction of roads, railroads, or other purely mechanical devices for hauling hardwood pulp or timber from areas already cut heavily for softwoods is admittedly financially prohibitive throughout most of this large area.

As to the former assumption, however, there is some room for discussion. Under present logging and driving methods such as are applied to softwoods, it is true that beech, birch, and maple have not generally been transported with any degree of success. Lumbermen have learned so much after comparatively few attempts and have let it go at that. Furthermore, the value of these species in the past has not been considered great enough to stimulate really thorough investigation in the matter of so improving their floating abilities as to enable them to be driven the required distances over given periods of time to the mills.

Today the increased utility of these woods for pulp is being recognized. An authority on the pulp and paper field, in a conversation with the writer two years ago, stated that if the hardwood transportation problem could be solved, the pulp and paper market could absorb the supply which would then become available. As a matter of fact, there is at present a shortage of hardwoods for soda pulp of roughly 200,000 cords which could easily be made up from our northeastern territory alone.

But to return for a moment to Mr. Cary's article. He points out that the method of restoring softwood lands by girdling hardwoods is being employed more extensively as its merits become more apparent. Despite the fact that there is no income from the trees thus killed and left to rot, there is evidently much justification for the process because of the resulting increase in growth of the established softwood regeneration.

Of course the extent of this method of improvement is decidedly limited. Thinnings, weedings, and the like must produce income in the near future at least if they are to be carried on indefinitely. Usually such cuttings are undertaken only as the resulting products attain sales value. And such limitation will naturally apply in the long run to girdling, although it seems justifiable at the present time.

Now, would not a method which permitted of the profitable disposal of the hardwoods now wasted be even more justifiable? In addition to the benefits

resulting from increased softwood growth and the rehabilitation of softwood sites, there would also accrue an income from the products of the "weed cutting."

Such a cutting would, of course, open up a tract a good deal more than at present. The area of mineral soil exposed per acre would be larger, thereby creating much more favorable conditions for increased softwood regeneration as well as better opportunities for advance growth.

How is this twofold purpose to be accomplished? What steps must be taken to adapt these hardwoods to river transportation? As the writer sees it, the ultimate success of river driving depends upon the efficiency of the methods used in preparing the logs or bolts for water carriage.

The basic principle involved is, briefly, the preliminary drying out of the sticks to such an extent that their final moisture content at the end of the drive, allowing fully for water absorption en route, will still be low enough to prevent excessive sinkage. The writer is sure that this can be accomplished by the use of special cutting and piling processes, which, while entailing no great cost, will ensure a maximum of drying over a given period.

In order to dry the wood to the proper extent the following facts must be determined: The moisture content at which sinkage will generally take place, the minimum moisture content which can be achieved by drying, and the rate of water absorption over a period approximating the average time of drive.

These facts can be definitely and conclusively discovered by continuing in a thoroughgoing, coördinated manner the experiments which have already bee[n] conducted in the way of cutting met[h]ods, piling methods, and floatability tes[ts] in still water. These have been carri[ed] on by a small number of timber a[nd] pulpwood operators in the United Sta[tes] and Canada who have endeavored, ind[e]pendently, and never thoroughly, to im[prove] in one way or another the po[or] floating qualities of hardwoods. Som[e] have made floatability tests. Others ha[ve] driven sticks after special drying, but a[p]parently the subject has not as yet bee[n] scientifically dealt with.

Enough has been accomplished in th[is] way, however, to indicate that the pos[si]bilities are strong that the problem, [if] properly approached and systematica[lly] analyzed, can be solved and commerc[ial] water transportation of the species ma[de] a certainty.

Girdling prior to cutting, and peeli[ng] and splitting after cutting have been [re]sorted to. One method tried with som[e] success by a Canadian lumber conce[rn] was to cut the logs in winter, peel the[m] partly around June 1st, and dry them [on] skidways for 8 to 10 days before dri[v]ing. The moisture content was there[by] reduced 10 to 20 per cent and the pro[hibitive] losses previously encountered u[n]der ordinary driving conditions we[re] done away with on this particular dri[ve] of 100 miles.

Similarly, other timber operators ha[ve] dried their logs on skidways in op[en] places, exposed to the full effects of su[n]shine and wind. Often skids were plac[ed] between each row of logs to permit [a] better air circulation. The small amou[nt] of loss for a driving period of 6 to [?] weeks in one case was found to just[ify] this careful handling.

Another practice employed was to cut the trees in the spring, allowing the tops to remain on until July or August when they were bucked up and peeled and left over winter on the banks of drivable streams. This method was found to be unsatisfactory where the logs were converted into lumber, because of loss of "live color" caused by the rapid removal of the sap and because of heavy checking, resulting in their deterioration for lumber purposes. These drawbacks, however, would not affect in the least the utility of the logs for pulpwood. In fact, according to Colonel Serlochius, the Finnish pulp manufacturer, white birch in Finland dried in this fashion has been successfully driven long distances over long periods covering often two seasons during the trip to the mills.

The foregoing examples, by no means all, have been cited merely to indicate the direction and extent of the efforts thus far made to solve the problem. A series of coördinated experiments in which all previous methods would again be tried together with untried theories of drying, over say a three-year period, would go a long way at the very least in proving the feasibility of commercial hardwood driving.

To illustrate roughly: It would be an easy task to locate an area adjacent to drivable streams of some 3 square miles from which the softwoods have been mostly removed, leaving a residual hardwood stand of about 5 million board feet of which say 4 million feet would be available for pulpwood.

Cutting would be purely selective with the purpose uppermost of providing for softwood rehabilitation. But in this case, only sound or mostly sound material would be selected for water transport because of the heavy losses which would be suffered in floating decayed sticks—large, decadent "wolf" trees could, of course, be girdled and left as at present.

The last of the cutting methods described above might well be employed among others; *i. e.,* cutting in spring, leaving the tops, then bucking and peeling later. Part of the cut might be bucked up in 8-foot lengths, part in 4-foot lengths, and perhaps part in longer or even shorter lengths. These would then be stacked separately by length in loose piles in open places along the streams, and if possible lengthwise to the prevailing wind to ensure maximum drying. If winter-piled along lakes, logs would never be placed on the ice, as even softwoods may absorb sufficient moisture in this way to sink in excessive quantities.

Samples of wood from the various piles would then be obtained at this time for the purpose of making the first measurements necessary to determine green weight, air-dry weight, and oven-dry weight (solid wood content). Immediately before driving, samples would be taken from the same, but now air-dried, material and these oven-dried.

Instead of driving the entire cut at once, a known volume of cordage would be placed in still water, and properly secured, for the purpose of determining the floating capacity of the various sizes and species. The behavior of the material would then be studied and record made as sinkage of the various units occurred, and particularly of the time when sinkage became general. In this way rate of absorption and floating time would become known and the knowledge then applied to future drives. For example, it might be found that sinkage became excessive (over 8 to 10 per cent

by volume) after an immersion of 75 days. As applied to the drive, this would mean that it would be necessary first to take steps to keep the sticks moving, especially across lakes where, under the usual methods of driving, logs often remain for many days until favorable winds drive them again into the current, and second to remove them from water at the end of the drive before the maximum period of 75 days had been reached.

The logs or bolts to be driven might be separated according to length or method of drying used, the various batches being thrown in at say 2-day intervals. The idea, of course, would be to determine the optimum length or method of drying for water carriage.

Effort would also be made to improve streams, booms, and methods of handling in order to speed up driving time. And at the end of the drive the heavier sticks (if in long lengths) would be removed from the water first as these would be most apt to sink. In any case, the quicker the removal the less the sinkage.

The experiment outlined above is only suggestive of what might be accomplished in a scientific manner. Most important of all is thoroughness and completion of all the necessary steps.

Several methods of cutting, drying, etc., might, of course, be used at the same time. Trees in one part of the tract might be cut in late fall or winter and dried by one method, and driven in spring; while cutting on another portion might continue in spring and the logs be driven the same season, or even the next.

Indeed such research might be und taken to even better advantage on th mixed areas still remaining from whi the softwoods are now being or have r as yet been removed for pulpwood. N that the problem is recognized, why co tinue the old processes of lumberi when we know only too well what going to happen?

If the order of cutting were revers on these lands, the hardwoods being c out first (experimentally in the begi ning until their adaptability to wa haul were decided), and the softwoo then removed 2 or 3 years after, t chances of the latter species dominati the site would be far more assured. the ensuing period, there would m likely occur a good distribution of se under favorable seed-bed conditions a with sufficient shelter for the reprod tion from the remaining cover to give i good start.

Certainly experimentation would of much value, for the potentialities this field have not been accorded t recognition which they deserve.

A determined effort to solve once an for all the question as to whether or n hardwoods are fundamentally adapted driving would produce results of mat rial benefit to at least the pulp and pap industry. If it is worth while merely destroy our hardwoods in order to r store the land to maximum productivit there is all the more reason for accom plishing the same end by means whi will ensure their profitable disposal in the bargain.

RECRUITING LUMBERMEN

By EMANUEL FRITZ

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LUMBERMEN do not take much interest in forestry schools. Is it because they fear or distrust them as possible sources of impractical ideas and propaganda to be used against themselves, or is it because they are not familiar with what forestry schools are really attempting to do? It has not been many years since it was only the occasional lumberman who took the least interest in a college-trained man, let alone the school that trained him. This refers to university training in general. He himself probably came up from the ranks, is a self-made man, and succeeded only after a very hard struggle. He speaks with pride and satisfaction of his 30 or 40 years of experience as a lumberman, or as a lumber salesman, or as a lumber retailer; and he is too inclined to believe that the only way to learn the lumber business is to begin young and as a lumber piler, and that no school can even begin to teach a young man a thing about lumber.

That day is passing, and college-trained men are gradually making their way into the lumber industry. The self-made lumberman himself is sending his sons to college and many sons of lumbermen have become prominent in university life. However, it is the rare lumberman's son who enters a forestry school. Usually he enrolls in engineering, or in commerce, or in letters and science, but rarely does he register in forestry, or even elect any of the forestry courses when he is enrolled in another department. Why is this? Do the forestry schools have no standing in the eyes of the lumber industry, or don't they offer the courses that lumbermen think should be offered, or do they fall down in not making themselves and their work known to lumbermen?

The early foresters were very energetic and militant crusaders. They saw the need for a change in our federal land policy and in the way timberlands were being handled. They performed a valuable function in arousing an active interest in the handling of trees as a crop. But at the same time they incurred the displeasure of the lumber industry, so much so, in fact, that many lumbermen still look upon foresters as people fired with radical and impractical ideas which they want to impose upon the industry, much to its expense and inconvenience. But such is far from being the case. Many men were certainly attracted to the forestry schools because they were fired with enthusiasm for the type of forestry of their militant elders. On the other hand, many other young men entered the same schools with no other intention than to become better acquainted with the forest, the harvesting of logs, and the utilization of the wood in preparation for a job with a lumber company. Unfortunately, these young fellows, upon graduation, suffered the same criticism as their classmates who took up forestry as a cause. Thus may

be explained the natural aversion or prejudice of most lumbermen toward university training and their distrust of the motives of forestry schools as affecting their interests.

We might as well admit that of the many things that are wrong with the lumber business, the lack of a personnel equal in training and ability to that of competing industries is outstanding. Other industries are usually a jump or more ahead of the public in their anticipation of new conditions. The lumber industry has ignored changed demands and is now puffing along out of breath in an effort to keep from being outdistanced. The ranks of the manufacturers of lumber substitutes are full of men whose preliminary training was received at colleges or from their own employers in accordance with definite plans. The trained fellows are taking away lumber's market. In a debate the "practical" lumberman is easily outclassed by his trained competitor.

If trained men can take the market away from lumbermen, why could they not, if employed by lumbermen, bring it back—or help hold what is left of it? Today training counts heavily whether it is obtained in school or outside—provided it is real training. How many lumber salesmen, for example, have been genuinely trained for their work, I mean trained to *create* business and not merely to obtain orders by underselling? Mighty few of them can give a really intelligent argument for wood. In saying this, I am fully mindful of the "stir of might" in the lumber industry at the present time and that in its big trade promotion campaign it has gone after just the type of men I have in mind. But this splendid federated effort is doomed to failure no matter how good its personnel, if the individual companies in the industry not match the association effort wi equally high grade effort on their pa or else at least exercise some patien and give the association's trained men fair chance.

Compared to enrollments in enginee ing schools, comparatively few youn men enrolled in forestry schools, and y the greater lumber industry compares f vorably with the steel industry in numb of men employed. One would think th many boys should find the same fascin tion in lumbering or one of its branch as so many boys find in the steel indust or its branches. Instead, they seem have an idea that lumbering is a lo grade and cheap industry and therefo they avoid it. It is fortunate that man more do not elect to enter a forest school with the intention of eventual going into purely forestry work, becau that field at present is not big enoug for a large number of graduates. B the lumber industry really needs bett trained men in considerable numbers. is pathetic that the industry does not e courage more men to include in the university course at least a few cours concerning lumbering and forestry tha should help them in their business, pr viding, of course, their university giv such courses. The lumberman's s probably feels that the forestry scho cannot teach him anything that he canno learn better in his father's yard after h has graduated; the other boy probabl feels that the lumber industry is no worthy of his consideration. For the la ter, the lumber industry must take fu blame; for the former, the schools ma be somewhat at fault.

Let's run over very briefly the char acter of the courses given at the averag

forestry school. There are, naturally, such courses as silviculture, ecology, forest management and reforestation, which are designed primarily for the student who hopes some day to practice pure forestry. But there is nothing in these courses which would injure the lumber-minded student and nothing that would make of him an enemy of the lumber industry. Such courses have a great deal in them that would serve as a splendid background for a greater appreciation of the forest and of its products on the part of the future lumberman, just as a study of economics and of industrial history helps to form a splendid background for a business career.

Forestry schools, every one of them of any note, give also such courses as forest mensuration, wood technology, logging, lumber manufacture, economics of the lumber industry, and allied subjects. In mensuration the student is taught how to measure trees and how to cruise timber. In wood technology he is taught the structure of wood, how structure and properties are interrelated, how wood behaves in drying, what its uses are, and how it can be protected against decay and insects. In logging and milling, the student is taught every step from the felling of the tree to the loading of the lumber into cars, while in other courses are covered the various economic and business phases of lumbering. Surely these courses must contain something of value to the future lumberman.

Forestry schools, for various and good reasons, are most of them divisions or departments of state agricultural colleges; yet they are outstanding examples where such alliances are not the case, as, for example, Yale, Syracuse, Michigan, and Washington. In many respects, forestry is a branch of agriculture because it deals with the growing and harvesting of tree crops. But forestry differs so fundamentally and so vastly from pure agriculture that many believe that forestry schools should rank as separate colleges like our colleges of commerce, of mining, and of law. Perhaps their alliance with agricultural colleges, "cow" colleges as the engineer or commerce students dub them slightingly, or the fact that they are schools of *forestry* rather than schools or colleges of *lumbering*, or of forestry *and* lumbering, reacts to keep some lumber-minded student prospect away. Even though a forestry school may be smaller, its field is as broad as that of the whole agricultural college, taking into account as it does the study of the tree crop, its growing and harvesting, its manufacture into finished products, and the marketing of these products.

Perhaps we need somewhere in the West a school which emphasizes lumbering as a major field to be known as a College of Lumbering, and to be comparable to a standard college of mining. The central thought in such a school would be lumber production, handling, fabrication, and marketing, supplemented by courses in business administration, accounting, engineering, and enough forestry to give the future lumber executive an understanding of what forestry means and how through its practice lumbering can be made a permanent industry. Incidentally, the foundation and endowment of such a college of lumbering would be a lasting monument to a lumberman and would help soften the feeling that lumbermen have taken fortunes out of the forest but put little or nothing back into it.

In the above I may have been unnecessarily severe on the lumber industry.

However, I felt it necessary to make my statements emphatic. I know very well the history of lumbering and appreciate that many of its peculiarities have very good foundation, but that is no reason why the industry should be a slave to tradition and not undergo changes as have other industries. For example, in the foundries at one time a college man was a subject of ridicule. The foundry industry itself was then the business of hard-boiled and rough individuals who were satisfied that rules of thumb were sufficient for every operation. Yet few industries have benefited more handsomely in the last 20 years from the attention and study of technically trained men. Lumbering is a very fascinating business, and once a lumberman, always a lumberman. The spell of the forest; the ingenuity required in logging; the scream of the saws and the hum of the planers; the diversity of the properties of wood, its universal use, and its versatility in supplying so many requirements; all these arouse an interest in even the dullest mind.

The typical college men are not of the "white collar" type and do not expect soft berths upon graduation. By far most of them are willing to serve a period of severe apprenticeship and are willing to start their climb of the ladder like anyone else; they trust only to their better training to give them a running start to outdistance eventually their untrained competitors. The fact that some college-trained men have turned out t be failures should not be made an indic ment of the system. In this day o crowded colleges many boys enter wh should be barred. The college canno make something out of nothing, but certainly can and does give a good ma a foundation that would require a goo portion of a generation to get outsid The employer on his part should not ex pect a recent graduate to be able t "take charge" of a big job at once. Eac employer will have to give his employee opportunity for practical training. Man an employer has failed because he has no trained well his own executives. In fa an important function of any employ should be to train his personnel and to f it for greater responsibility.

It would be a good investment for th lumber industry to take an active intere in the forestry schools that give cours in lumbering. Certainly the schools a going to be no better than the lumber i dustry demands. If the industry takes n interest in them, they cannot be expect to develop the kind of men that a needed to keep the industry going in th future. Wherever there is a forest school, lumbermen, whether they be tim berland owners, manufacturers, distrib tors, or others, should make themselv acquainted with the personnel, equi ment, and courses, and let the faculti know that they are watching them an their product.

STATE POLICY IN FOREST LAND ACQUISITION[1]

By LYNN F. CRONEMILLER

Deputy State Forester of Oregon

AT THE TIME the Territory of Oregon was admitted to the Union, Congress granted to the state all surveyed Sections 16 and 36. In case of prior disposal the state selected lieu lands, and in case of unsurveyed territory the state acquired title when the area was surveyed. Included in this area was approximately 5 per cent of the total timbered area of the state, some of it of exceptional quality. The area was disposed of piece by piece at prices ranging from $1.25 to $2.50 per acre until only the more inaccessible or less valuable areas remained. These were widely scattered throughout the timbered areas of the state. This was the condition existing in 1912 when the State Forester and the Governor of the state inaugurated a movement to exchange these isolated tracts of school lands within the National Forests, totalling approximately 70,000 acres, for one solid block of National Forest land. Had the officials of the state at that time realized the delays and difficulties that confronted them in the exchange of the areas, they would have entered into the deal with some misgivings as to its ultimate success.

The state legislature in 1913, in anticipation of such an exchange, passed a law withdrawing from sale by the state, for a period of 50 years, any National Forest lands that might thereafter be patented to the state. In the same year, Senator Chamberlain of Oregon introduced a bill in Congress authorizing the selection of a specific tract of National Forest lands in lieu of the state lands. The U. S. Forest Service objected to this on the ground that the value of the National Forest area was considerably in excess of that of the state lands offered in exchange. This objection was a perfectly valid one but it served to dishearten state officials and as a result the project was abandoned for a time. Then the war occurred and the exchange was not again agitated until 1918.

At that time those who were advocating the exchange were favorably received by the legislature of the State of Oregon, as was evidenced by the passage of a law that specifically provided for the exchange of areas with the federal government. A memorandum of agreement between the state and the Secretary of Agriculture was drawn up and signed in 1920. This provided for the exchange on the basis of equal value and equal acreage in accordance with the laws of the State of Oregon. It also provided for a division of the cost of examination on a 50-50 basis between the state and the federal government.

Following an examination of the state lands and a determination of their value, the state selected a portion of the Siuslaw National Forest, known as the Millicoma tract, as a basis for exchange. This includes a solid block of National Forest land 12 miles wide and 20 miles long lying just south of the Umpqua River and about 8 miles from the Pacific Ocean. An intensive reconnaissance of this tract revealed the fact that it was of approximately the same acreage and

[1] Presented at a meeting of the North Pacific Section, Society of American Foresters, February 27, 1929.

value as the state lands. The exchange was approved and those interested felt that the transaction was about completed.

But again the deal was delayed. There was a considerable acreage of revested Oregon and California Railroad grant lands in the western edge of the area and it was necessary to include these in order to make up the necessary federal acreage. However, title to these could not be passed to the state without a special act of Congress. The necessary bill was introduced in Congress but was evidently doomed to failure on account of the opposition of the Department of the Interior. The department opposed the bill on the ground that the state and county each had a 25 per cent equity in the property and the federal government could not properly deed this away under the conditions. Officials of the county concerned, as well as the Governor of the state, were at once appealed to with the result that both wired the department urging the exchange. This action resulted in the department withdrawing its objections and in the subsequent passage of the bill. Apparently the last obstacle had been removed.

But the end was not yet, for the department again came forward with the announcement that a portion of the area had been withdrawn as power sites and only through certain fiscal procedure could this obstacle be overcome. The state immediately abided by the federal regulations, not with the optimism that applied to previous actions but rather with some misgivings as to what might happen next. Sure enough, the state was soon advised that the exchange could not be ratified until the Geological Survey submitted a report to the effect that there was no mineral values in the lands involved. This report has been made and
there the matter rests at the prese
time. It seems as though the only thin
left to do is for the General Land Offi
to issue the patents to the state.
fact, both the state and the Fore
Service feel so certain that the diffi
culties are over and that the final e
change will be completed within a sho
time that the state has made defini
arrangements to take over the patrol
the area during the coming summe
However, neither would be surprised
some condition arising that would del
the exchange for a time.

With the exception of a small pa
of the area, the proposed state fore
was burned over a number of years ag
At the time of the intensive examin
tion in 1921, a considerable part of t
area was classified as poorly stocke
The remainder consisted of a go
growth of trees ranging in size fro
seedlings to mature timber. Inspe
tions made subsequent to 1921 pro
that there are very few fail spots in t
area at the present time. It is all w
stocked. The growth of the trees h
been phenomenal, many of the termin
shoots revealing a yearly growth
from 2 to 3 feet. It is questionab
whether any area of like extent cou
be found anywhere in Oregon th
would have the same possibilities f
producing timber.

The area in itself—only 70,00
acres—is relatively small and represen
rather an insignificant share of the sta
responsibility as a partner in the owne
ship of forest lands in the state, but
does serve as a nucleus upon which
build future state-owned forests.

Owing to the fact that the area
largely second growth and that wh
merchantable timber is present is rath
inaccessible, no plans have been ma

relative to the tract other than for its protection and the improvement of trails and telephone lines. This part of the work will be conducted similarly to that of any protective organization in the state. In fact it is very likely that the area will be merged with some association, the state paying protection costs on an acreage basis.

Considerable thought has been given by the state forestry department to the acquisition of forest lands. A law has been passed providing for the acceptance by the state of gifts of forest lands, but to date no lands have been acquired under this act. No aggressive action has ever been taken to get the state to pass legislation that will permit the State Board of Forestry to acquire cut-over forest lands through purchase. The principal efforts in the past have been to get the state to stop selling what it had. It was not until 1925 that the State Land Board had authority to sell the timber and still retain title to the land. Prior to that time the state sold the land and naturally the timber went with it. Under the law enacted in 1925, the state can provide various restrictions relative to the harvesting of the timber and the disposal of the brush on the area. This will serve to keep the land in good condition for a second crop.

Approximately 60 per cent of the timbered area of the state is in the hands of the federal government. This includes the National Forests, Indian Reservations, National Park, vacant public lands, and O. & C. lands. The balance of 40 per cent, or approximately ten and one-half million acres, is in the hands of private owners and it is out of this 40 per cent that the state must secure its lands if it is to adopt a policy of land acquisition. Such a policy can tie in directly with the recently enacted reforestation measure. The law is designed, naturally, to keep forest lands in private ownership, but regardless of any favorable legislation, there will be lands that will eventually revert to the county. Dr. Fairchild has made the statement that there is no magic in taxation that will make an industry profitable where no profit is possible. The effects of taxation are negative only. It might remove one obstacle to forestry where all other conditions are favorable, but where such conditions do not exist the private owner will not retain title to the land.

This will be the case in Oregon in many instances where the soil is poor and the possibilities of tree growth limited, or there may be sections where the ownership is divided or the area is so small as to make it impossible to block holdings into sufficiently large areas to constitute a logging unit. It is unreasonable to expect an owner to retain title to lands where there is no possibility of a profit. It is plainly a state duty to take over such tracts, either through purchase or by tax foreclosure. The state should direct its efforts toward the blocking of units as much as possible but should not necessarily acquire only the less productive class of lands. It should have the authority to take over any tax-delinquent forest lands.

How much land should the state own? It is a difficult question to answer. A survey of the state as contemplated in the McSweeney-McNary act may aid in the solution of the problem. Again, developments under the reforestation act may give some indication as to the future policy of the state. It will most assuredly show the trend of forest land ownership within a few years and may answer the question of state ownership.

A FOREST SURVEY OF MASSACHUSETTS

By H. O. COOK

Chief Forester, Department of Conservation, Massachusetts

ONE of the first essentials in carrying on a business of any extent is an inventory showing the stock on hand. Our raw material in the forestry business is our forest land. Unfortunately, while we talk glibly both in national and state forestry affairs of this and that amount of forest land and forest types, our data are often based on the most cursory estimates. Some states have made some study of their forested area, but usually have not attempted to do much more than differentiate between the forested and non-forested land.

Fourteen years ago the Massachusetts State Forester commenced a town by town survey of the state using Worcester County as the first unit and continuing each summer with some interruptions until it was completed this past year. Mr. Harold Fay had charge of the survey in Worcester County and to him is due the credit of initiating the system which has been continued since with but few minor changes. Mr. P. D. Kneeland had charge of the survey in Plymouth County, Mr. R. M. Hick in Bristol County, and Mr. R. B. Parmenter in all the other counties. These men had a crew of two or three forest school students during July and August each summer in carrying out the field work.

The usual method of making such a forest survey has been to traverse all the roads in each town and to sketch in the open and forested land on a base m provided for the purpose. In fact, started our Worcester County Surv in this way, but soon found it inadequa Most of the open farming land lies alon side the road and the woodland is back of this open country. For this re son while it is possible to sketch in t boundaries of the forest land and make a pretty map, it is impossible obtain any adequate idea of the real co position, size, and density of the woo land without actually traversing Such a method, therefore, did not gi us the information that we most d sired.

The method of field work finally us was an adaptation of a large scale ti ber cruising system which we felt ga a maximum amount of information a minimum cost. Each man ran lines compass and pace, one-half mile apa from one boundary of the town to t other. For simplicity these strips we run north-south or east-west, dependi on the topography; that is, if the ridg and valleys ran in a north-south dire tion, the strips were run from east west, so as to cut the topography. T Geological Survey topographic ma were used as guides. At first it w thought that the half-mile strips wou yield sufficient data with which to co struct a forest map of each town. Owin however, to the manner in which o Massachusetts forest and farming are are cut up into small parcels, half-mi

strips are too far apart to give a reliable basis for a map. In one town we experimented with quarter-mile strips, and while the result gave reasonable satisfaction, the expense was so great as to make such a survey over the whole state out of the question.

Having given up the idea of a map, we experimented and found that one-mile strips gave as good an estimate of the forest conditions in a township as half-mile strips at little more than 50 per cent of the cost, so that in all the counties save Worcester and Plymouth one-mile strips were used. In the survey of these two counties the crew camped out, but in the subsequent county surveys the men were boarded at some central convenient place and the leader, provided with a car, transported them to their strips and arranged to pick them up at a predetermined place at night. It was the leaders' place also to make a forest report of each town, including a study of local forest operations and wood-using industries, if any. Such matters as gipsy moth infestation and, in the early part of the survey, chestnut blight infection were reported on. The men were provided with a hand compass, a counter for tallying paces, and a specially ruled note book on a scale of 1000 feet to the inch. By means of symbols much information could be recorded in a small space. For example, this notation, P. O. M. 2—3, 8, 700′, means a mixed stand of pine, oak and maple, pine predominating, of a size midway between classes 2 and 3, with a stocking of 80 per cent, which extended along 700 feet of line. The total number of feet in each type as compared with total number of feet of strip in the town is then proportioned into the total area of the town and the area of each type in acres calculated. For instance, if in town A, with an area of 20,000 acres, there was run 200,000 feet of strip line and 5000 feet of this strip was shown to be white pine, class 2, then it would be considered that 2.5 per cent of the area of the town, or 500 acres, should be classed as white pine 2. The data obtained in this way are very detailed, so that in working up the figures for publication it was necessary to combine a good many types and size classes with consequent loss of much detail.

The expense of such a survey is not large. A crew of three men usually covered about three towns per week and the cost, including labor, board, and travel, averaged between $30 and $40 per town, or about $1000 for a county.

We have combined the results of the surveys in each county into two general tables. Of these, Table 1 shows the area of the state divided into five land classes. I should add here, parenthetically, that the city of Boston, Suffolk County, and a number of cities of Middlesex County in the Metropolitan District which have practically no forest or agricultural land, were not surveyed and are not included. There are, therefore, about 60,000 acres of land not represented in this table, which if included would be in the column headed business and residential, bringing the total of that type up to 380,000 acres, or 7.5 per cent of the total.

Abandoned fields and pasture coming up to brush and scattered tree growth were classified as transition land, because while not forest area at the time of the survey they will be in from 10 to 20 years. This transition land, added to the forest area, makes what we call the potential forest area of Massachusetts

3,226,000 acres, or 62 per cent of the area of the State. Agricultural land includes all open areas reasonably adapted to tillage and pasturage, although by no means all the area so classified is being used as such. The state census of 1925 gives tillage land as 682,000 acres and pasture as 877,000 acres, of which, however, 482,000 acres is called "woodland" pasture. The total census figure for pasture and tillage is about 100,000 acres more than the survey shows. Undoubtedly most of that excess will be found in our transition type of brush pasture. The terms residential and business are self-explanatory. It is not always easy to draw a hard and fast line where urban conditions stop and rural begin. During the past ten years there has been a decided tendency for our towns and cities to spread out into the open country. Water and marsh include not only fresh water ponds and open meadow swamps, but salt water inlets and salt marshes which form a considerable percentage of land area in our seacoast towns.

Table 2 includes the forest area divided into 12 types and 4 size classes. It is, of course, a difficult matter to divide our forest land into definite size classes by hard and fast lines. Class 4, the smallest, in general includes both seedling and sprout growth from 1 to 12 years of age and two inches or less in diameter. Class 3 includes sapling growth from 12 to 35 years of age, 20 to 35 feet in height, and 2 to 6 inches in diameter. With cordwood species such as oak and maple this type in some localities might have a very low merchantable value. It is of interest to note that

TABLE 1

CLASSES OF LAND IN MASSACHUSETTS BY COUNTIES

County	Forest[1]		Transition[1]		Agricultural		Residential and business		Water and marsh		Total Acres
	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent	
Plymouth ..	304,133	68	......	...	84,219	20	18,565	4	33,649	8	440,566
Hampshire	162,839	48	73,302	21	86,534	24	5,837	2	14,527	5	343,039
Norfolk ...	153,190	52	13,381	5	95,755	32	24,654	9	6,988	2	293,968
Worcester .	574,964	57	57,570	6	316,524	31	25,475	3	27,341	3	1,001,874
Franklin ..	280,398	62	21,763	5	131,303	30	6,779	1½	6,100	1½	446,343
Hampden .	239,229	59	29,734	7	105,828	26	23,585	6	8,732	2	407,108
Middlesex .	300,287	46	41,000	6	197,091	29	102,300	17	12,422	2	653,100
Berkshire .	325,473	54	74,925	13	177,600	30	14,651	2	8,291	1	600,940
Essex	109,910	31	38,808	11	124,270	38	32,585	10	31,661	10	337,234
Barnstable	151,759	60	23,759	9	34,322	12	32,152	12	20,954	7	262,946
Bristol	207,390	56	18,850	5	87,620	24	30,008	8	23,760	7	367,628
Dukes	25,786	40	19,670	26	4,297	5	2,560	3	19,473	26	71,786
Nantucket .	660	2	15,500	48	800	2	1,280	4	14,000	44	32,240
Total .	2,836,018	54	428,262	8	1,446,163	28	320,431	6	227,898	4	5,258,772

[1] The sum of these two classes gives the total area of potential forest land.

2,273,000 acres, or 80 per cent of the forest area, is in general under 35 years of age. The reason is not far to seek, because under present conditions in this state as soon as a growth has attained some commercial value, even for fuel wood, the owners commence to cut it off. Class 2 includes trees from 35 to 50 years of age, 35 to 55 feet in height, and 6 to 10 inches in diameter. A stand in

possible to construct an indefinite number of types, but the eleven indicated cover the conditions for all practical purposes. The white pine type includes not only pure pine areas but mixed stands where pine is clearly predominant. The mixed pine and hardwoods type generally has more hardwoods than pine, the hardwoods being chiefly gray birch, maple, and oak, the latter found chiefly in size

TABLE 2

FOREST AREA OF MASSACHUSETTS BY TYPES AND SIZE CLASSES

Type	4 0″–2″ Acres	3 2″–6″ Acres	2 6″–10″ Acres	1 10″ + Acres	Total Area Acres	Per cent of forest
White Pine	69,191	105,904	83,742	40,970	299,807	10.6
Pine and Hardwoods	101,948	141,988	55,627	19,750	319,313	11.3
Hemlock	4,118	7,437	6,126	2,750	30,431	0.7
Hemlock and Hardwoods	34,997	43,596	28,576	8,409	115,578	4.1
Spruce	6,128	12,221	5,128	1,871	25,348	0.8
Spruce and Hardwoods	8,363	15,498	4,806	1,183	29,850	1.2
Other Softwoods	13,453	28,872	12,559	2,768	57,652	2.2
Pitch Pine and Oak	134,817	75,353	21,713	2,020	233,903	8.2
Oak	235,034	194,845	89,391	26,662	545,932	19.2
Northern Hds	236,160	224,235	76,759	21,149	558,303	19.5
Scrub Oak	64,811	......	......	......	64,811	2.2
Gray Birch and Maple	329,310	186,013	42,828	7,814	565,965	20
Total Area	1,238,330	1,035,962	427,255	135,316	2,836,893	
Per Cent of Forest	43.7	36.8	15	4.5		100.0

his class will produce first quality cordvood and in the case of softwoods will ontain some sawtimber. Class 1 conains all growth larger than the precedng classes. A stand in this class will e of sawtimber size and one notes that includes less than 5 per cent of the orest area.

Because the forests of Massachusetts re on the border line between the northrn and southern forest types they conain a large number of species and it is

classes 1 and 2. It is encouraging to note that these two important types together constitute 22 per cent of the forest and that there is relatively a good percentage in the upper size classes. Hemlock is found in small bunches in nearly all the counties of the state except Plymouth and Barnstable, but spruce is confined to the higher elevations of the Berkshire hills. The hardwoods in mixture with spruce are beech, paper birch, and hard maple. The "other soft-

woods" need some explanation. In some counties the amounts of pitch pine, spruce, and hemlock were so small in area that they were put under a miscellaneous classification as "other softwoods." In southern Massachusetts it included also the swamp white cedar, hence this type is not confined to species other than those named above as the title might suggest. In pitch pine and oak, the oak refers both to the true scrub oak and to tree oak species. Generally speaking, the pitch pine and scrub oak types are found in those sections of the state which have been severly burned. Where fires are kept out the tendency of this type is to become a mixed pitch pine and sprout oak stand.

The oak type in the original surveys was called the oak-chestnut type, but the chestnut has largely disappeared and been replaced chiefly but not altogether by oak, for besides oaks there are ash, hickory, soft maple, gray birch, and sometimes paper birch in this type. The key trees of the northern hardwoods type are, of course, beech, paper birch, and hard maple, but ash, yellow and black birch, and often oaks are present. The scrub oak type needs no definition. Where there was a high percentage sprout tree oak in mixture this type w placed under oak 4, and where the was a good percentage of pitch pine production under pitch pine 4; her this type is not as large in area as might seem that it should be. Our pol in placing stands in types was to lo ahead 8 or 10 years and to classify th with regard to their future conditi rather than merely on the circumstan of the moment. In the gray birch a red maple type, the birch predomina in younger age classes and maple in older classes and also on low, wet lan This forest weed type, one notes w dismay, covers 20 per cent of our for area.

No attempt has been made to go step further and to turn these area figu into stand figures in board feet or cor although this could be done by a skil use of existing yield tables. Proba each one who attempts it will get a c ferent result. What is needed is not o a table showing the present stand also one showing the commercial po bilities of the now unmerchantable ty and size classes.

COÖPERATION IN THE SOLUTION OF SOUTHERN CALIFORNIA'S FIRE PROBLEM[1]

By SPENCE D. TURNER

Forester, County of Los Angeles, California

THERE are few places in the United States where the fire control problem is as hard to solve as in southern California. The mountainous part of this region, comprising some eight counties lying south and west of the Tehachapi, Sierra Madre, and Coast Ranges, has practically no timber of merchantable value, but consists rather of dense brush fields, in most cases rising abruptly from the coastal plains. These brush fields, however, retarding as they do the run-off from winter rains not only guarantee the summer water supply but also protect the valleys from flood damage, and are therefore of the greatest economic importance to the welfare of this region.

Climatic and soil conditions in the valleys lying at the base of these brush watersheds are such as to make them, when under irrigation, highly suitable for agricultural purposes, particularly for the raising of citrus and other semitropical fruits. In fact, taken acre for acre, this area now contains the most valuable agricultural land in the United States. Furthermore, the climate and scenery, coupled with the easy accessability to both the ocean and the mountains, is rapidly making southern California the all-year playground of the United States; yet the resulting enormously increasing population is, with the possible exception of the city of Los Angeles, absolutely dependent for its domestic water supply on these same watersheds. In the meantime, the recreational value of this mountain area is increasing rapidly, mountain land adjacent to the National Forests being bought at high prices and turned into private estates by wealthy men.

To realize fully the value of these brush watersheds let us take some actual figures for Los Angeles County. The entire area of this county is slightly over two and a half million acres, of which less than one million acres, or two-fifths, is watershed area. Of the balance, half a million acres consist of actual city blocks and one million of agricultural land, half of which is under irrigation and the other half irrigable if more water were available. In 1928 the agricultural crop production of Los Angeles County amounted to over $93,750,000, of which it is estimated that $60,000,000 represented the value of crops grown on irrigated lands. This latter amount, capitalized at 10 per cent, would give a capital value of $600,000,000. Exclusive of the Los Angeles aqueduct (75,000 acre feet per year), the safe yield per year for agricultural and domestic use from gravity flow and pumping is about 400,000 acre feet. At an average yearly rental of $12 per acre foot, this represents a capitalized value of $480,000,000. Value of

[1] Presented before the Western Forestry and Conservation Association, Seattle, Wash., March 19, 1929.

watershed cover may be computed many different ways. Los Angeles County is now spending a $35,000,000 bond issue for the control of floods emanating from her one million acre watershed. This watershed area (outside of National Forest land) has been selling for recreational purposes at from $500 to $1500 an acre.

In view of the above facts, the claims of southern California conservationists, who put a value of from $500 to $1,000 on an acre of brush watershed, are not as exaggerated as one might think.

The same climatic conditions so beneficial to the growing of crops and so attractive to the wealthy easterner in search of relaxation or recreation nevertheless create in this region a condition of extreme fire hazard unequalled elsewhere. Brush is inflammable at its best; in southern California, growing as it does on precipitous slopes, with an average rainfall for the last ten years of 12 inches, it becomes as explosive as gasoline. Yet this mountain area is in close proximity to some three million people, the majority of whom have not the slightest idea as to either its value or its inflammability.

Hot winds blowing in from the San Joaquin Valley and from the Mojave and Arizona deserts create periods of extreme high temperatures and correspondingly low humidity, when a fire, once started, is almost impossible to put out. During the past five years, due to these periods of low humidity, disastrous fires have occurred in every month of the year, giving practically a yearlong fire season.

All patrol stations of the Los Angeles County Forestry Department are equipped with recording instruments. The following readings from these giv a good idea of conditions:

Station and date	Hour	Temperature degrees F.	Relative humidity per cent
Newhall,	8 A. M.	69	32
Sept. 1, 1928	12 M.	97	8
	5 P. M.	95	11
Altadena,	8 A. M.	67	16
Nov. 20, 1928	12 M.	76	1
	5 P. M.	67	13
Altadena,	8 A. M.	50	0
Feb. 26, 1929	12 M.	59	9
	5 P. M.	59	21
Fernando,	8 A. M.	50	17
Feb. 26, 1929	12 M.	65	10
	5 P. M.	60	14

These stations are all located in th open foothill country and not in bo canyons, and are all within 20 miles o the ocean. The readings are taken wit Tycos hygrometers, which are reliabl as shown by frequent checks against mor expensive instruments. During the sum mer months the humidity frequentl stays below 10 per cent for days at a time with the nights as bad as the days, mid night readings frequently showing hu midity below 8 per cent and temperatur as high as 85° F.

In this southern California area ar five agencies responsible for its fire pro tection. These are federal, state, county private, and municipal, there being sev eral instances where cities have extende their municipal limits into the watershe area, sometimes even including portion of the four National Forests (the Sant Barbara, Angeles, San Bernardino, an Cleveland) which cover at least 75 pe cent of the entire watershed area.

The State Board of Forestry ha placed a yearlong forest inspector in thi area, with a full time ranger in River side County together with a fire fightin

truck. The state has also entered into coöperative agreements with other counties on a 50-50 basis covering salaries of county wardens and firebreak construction expenditures.

Several counties, particularly Los Angeles, Santa Barbara, Ventura, San Bernardino, and San Diego, have strong County Forestry or Fire Warden organizations, supported entirely by the respective counties.

The private agencies interested are nearly all water companies, and usually confine their activities to extending financial coöperation on a 50-50 basis to either federal or county agencies for the hiring of additional patrolmen or lookouts, although there are a few organizations along the foothills, such as the Angeles Forest Protective Association, which hold monthly meetings and have highly organized volunteer crews ready to report in any emergency to federal or county forces for actual fire line duty.

A bill introduced at this session of the legislature will, if passed, allow municipalities to contract with county governments for watershed fire protection, thus solving a situation which in the past has been dangerous, due to the fact that a regulation fire department is usually inadequately equipped and trained when it comes to fighting mountain fires.

Some two years ago, the City of San Bernardino presented to the United States Government a nursery site at Devils Canyon for the establishment of a branch of the California Forest Experimental Station, to work on southern California problems, and this station is to a great extent supported financially by funds from southern California counties.

Some three years ago Congress authorized a special fire prevention appropriation for these four forests, provided it was matched by a like amount from other agencies. This year the appropriation amounted to $125,000, which does not begin to match the money being spent by other agencies.

It is only natural to suppose that with so many agencies working in the same area, and towards the same end, there would be overlapping of work and decentralization of control with its attending friction and dissatisfaction. That this, however, is not the case can easily be seen from the methods which are used in Los Angeles County and which are more or less standard in this region, differing only according to the amount of money available in the various counties.

For the fiscal year 1928-1929, Los Angeles County appropriated $1,400,000 for the various functions of its Forestry Department, of which some $400,000 is used directly for watershed fire protection and control, with an additional $100,000 for reforestation work. As nearly three-fourths of the county's watershed area is inside the Angeles Forest, this money is spent to a large extent in giving additional protection to the National Forest. Firebreaks, trails, telephone lines, etc., are constructed inside of the forest by county crews under county supervision. The county built and paid for five steel lookout stations inside the forest; now the Forest Service is paying for the observers until such time as the salaries paid equal the cost of construction, after which the expenses will be shared on a 50-50 basis. All of the reforestation work done by the county is inside the forest. An iron-clad coöperative agreement between the forest supervisor and the county forester handles the coöperative fire prevention and suppres-

sion work, each organization doing its own improvement work and maintaining its own patrol forces and stations. All borderline fires are paid for on a pro rata basis, while during large fires inside the forest, the county forces, upon request, set up their own camps, taking over certain designated sections of the fire. In addition, Los Angeles County made a straight appropriation of $47,500 last year to the Angeles Forest for fire prevention work. The State Board of Forestry annually enters into a coöperative agreement for firebreak construction, putting up $25,000 for this purpose which is matched by Los Angeles County. This money is to a large extent spent inside the forest, in fact the county forester turns over $12,000 of this amount to the Forest Service to spend as his agent, thus providing funds that enable the Federal Service to keep up an ample yearlong personnel.

The state forest inspector attends and works on all fires whether federal or county, without charge, and is given free office space in a county station.

Last year the county forestry budget carried an appropriation of $1,500 for the southern branch of the California Experiment Station; this year it will probably be raised to $2,500.

Coöperative fire fighting agreements covering border-line fires have been entered into between Los Angeles County and the county forestry organizations in Ventura and San Bernardino counties, with the Santa Barbara National Forest, and with the State Board of Forestry covering Orange and Kern Counties. These agreements go into great detail which experience has shown to save both time and trouble.

Such briefly is the manner in which southern California is now attempting to solve what is probably the most serious and pressing problem facing her, that of maintaining an adequate water supply and preventing flood damage.

ON THE OCCURRENCE OF ROCK-LIKE CLINKERS IN BURNING SNAGS

By RAYMOND KIENHOLZ
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THE OCCASIONAL finding of rock-like clinkers in partially burned snags has aroused considerable interest among foresters. This fact will make an article[1] which appeared recently in *Science* of particular interest. It is my purpose here to call attention to this article, briefly summarizing the authors' findings and adding certain observations which I have made or have gathered on the circumstances under which these clinkers have been found.

The article cited is based on the analysis of a sample of clinkers from western hemlock found following the Wind River (Washington) fire of 1925, a sample of sound hemlock wood from the same locality, and two samples of clinkers from western hemlock from the Kaniksu National Forest. The author's analyses of the clinkers show a high percentage of calcium oxide (about 22 per cent) and potassium oxide (30 per cent), with lesser amounts of the oxides of phosphorus, magnesium, manganese, and sodium and with mere traces of chlorine and the oxides of silicon, iron and aluminum, and sulphur. The composition of the ash of the sound wood was very similar to that of the clinkers from the same region. From this they draw the conclusion that the clinkers are "probably due to the collection of a large quantity of the ash in the hollow snag," and "a fusion of the mass during a later vigorous burning of the surrounding wood." They maintain that the clinkers are not of meteoric origin as has been suggested by some, the greenish tinge of the clinkers being due to manganese and not copper. Furthermore the analysis shows little iron and no nickel, which are usually common constituents of meteorites.

The rather frequent finding of these clinkers in recent years makes it appear that they are more common than was formerly supposed. Information concerning their occurrence is widely scattered, however, and the following cases are discussed in the hope that those who have additional information will communicate with the writer. Thanks are gladly given those who have already furnished me with information.

Geographic Distribution

So far some five authentic cases of the occurrence of these clinkers have come to my attention. All of them are located in the Northwest as indicated below. No definite information is available to indicate their occurrence in other forested regions though it is probable that they do occur:

Columbia National Forest. In 1925, following the Wind River fire, Ranger Blodgett found clinkers in hemlock and

[1] Englis, D. T., and W. N. Day. The composition of peculiar clinkers found in snags after forest fires. *Science* 69: 605-606, June 7, 1929.

some were secured for analysis. He has found them "at different times, in probably a score or more trees."

Kanisku National Forest. In 1927, the year following the great fire, clinkers were found near Kalispell Bay, Priest Lake, and samples were secured for analysis from Mr. H. T. Gisborne of the Northern Rocky Mountain Forest Experiment Station. Another similar case was found later near the Bismark Ranger Station.

Clearwater National Forest. In 1924, while "mopping up" after a severe fire, clinkers were found in a number of western red cedars.

Umatilla National Forest. In 1927, Ranger Baker reported finding clinkers south of Spout Springs. In 1928, he reports a similar experience. His account, appearing in the Six Twenty-six for September, 1927, attributed the clinkers to meteorites. In the November issue Mr. T. T. Munger, director of the Pacific Northwest Forest Experiment Station, denied the possibility of the clinkers being meteoric in origin and responsible for starting the fire.

Mr. W. B. Osborne, Inspector of Fire Control in District 6, has frequently found clinkers, some of which have been analyzed by Professor Mears of Williams College. Mr. Osborne, in a personal letter which is freely drawn upon here has very well summarized his knowledge concerning the occurrence of these clinkers.

A rather doubtful occurrence is reported from the Cœur d'Alene National Forest in 1923, four years after a fire. The clinkers were seen at a distance while looking down on the snags from a steep hill and were not closely investigated. This is unfortunate as they were probably in white pine, a species not far reported as forming clinkers.

Species of Trees Forming Clinke

In most cases the clinkers have bee found in western hemlock (*Tsuga hete ophylla*). Ranger Blodgett has foun them in many trees but "never in an thing but green hemlock" with rotte hearts. Mr. Osborne reports them "mo frequently" in western hemlock, "qui frequently" in Douglas fir (*Pseudotsu taxifolia*) and "occasionally" in nob fir (*Abies nobilis*) and white fir (*Abi grandis*). He believes the small numb of cases reported from noble and whi fir is due to the comparatively small num ber of individuals of these species as com pared to Douglas fir and hemlock. H has never found them in western yello pine (*Pinus ponderosa*). On the Clea water they were found in western re cedar (*Thuja plicata*) and on the Uma tilla in white fir. On the Cœur d'Alen they may have been in western whi pine (*Pinus monticola*), though this wa not verified.

The extremely high percentage o cases of hemlock forming clinkers d spite the fact that hemlock makes u only a relatively small percentage of th stands in the region considered is prob ably due to the heavy infection of th hemlock with rot. Hubert[3] reports th older age classes (100+ years) of hem lock as being almost 100 per cent in fected.

Fungal Decay

The clinkers seem to be formed onl by the burning of trees with a rotte heart surrounded by sound wood. Th

[3] Hubert, E. E. Manual of wood rot. *Tim berman* 28: January-April, 1927.

a narrow cavity of considerable depth is formed as the rotten wood burns out. The Columbia clinkers were found only in hemlock heavily infected with Indian paint fungus (*Echinodontium tinctorium*). It is not known whether the tree in which the Kaniksu clinkers were found was infected with the Indian paint fungus, but this seems likely as many of the surrounding hemlocks were. Mr. Osborne states that in many cases the heartwood was known to be rotten, in others the fire burned as if it were burning in rotten wood but no examination was made. In no case was the kind of rot determined. Indian paint fungus is described by Hubert as producing "a trunk rot" which "in older trees occupies the entire heartwood," very frequently reducing the trunk to a "mere shell of sapwood." "It is the principal rot of western hemlock, alpine fir, and lowland white fir." It is also found in Douglas fir. There are other fungi causing serious and extensive heart rots in various species of conifers in this region. Red cedar is not listed as being attacked by *Trametes pini,* a very common heart-by the Indian paint fungus but is attacked rot-producing fungus destructive also to Douglas fir. The production of clinkers is probably not limited to the burning of wood rotted by any one particular kind of fungus, but where conditions are proper follows the burning of any rotten wood. Mr. Blodgett believes that the burning of sound wood, if carried out under the proper conditions, would result in the formation of clinkers. He has found similar clinkers in boiler fire boxes burning clean saw dust where much of the cut was hemlock. In the vicinity of Brinnon on the Olympic Peninsula, he has observed very little infection by Indian paint fungus and he has found no clinkers following fires in that region.

Size and Shape of Cavity

The clinkers have always been found in deep cylindrical pockets, which seem to be necessary for the accumulation of ashes and the formation of clinkers. Ranger Blodgett has found clinkers in cavities ranging from 2 to 12 feet in depth located from 4 to 40 feet above the ground in trees from 1 to 4 feet in diameter. On the Kaniksu the pocket was 20 inches in diameter and 3 feet deep located some 25 feet above the ground in a tree 3 feet in diameter. The Umatilla clinkers were found in a snag 60 feet high in a very deep pocket (20 inches by 20 feet) in a tree 28 inches in diameter at a height of 60 feet.

Mr. Osborne reports the cavities as 4 to 40 feet deep and 1 to 4 feet in diameter, no clinkers being found in small trees, probably because they are not severely rotted.

Amount and Character of the Clinker Material

The amount undoubtedly varies widely with the size of the tree and the length of the burning period. On the Columbia the clinkers varied from the size of a man's fist up to what would fill a bushel basket and weigh 100 pounds or more. Mr. Osborne reports much the same. On the Kaniksu the clinkers were estimated at about 1½ bushels weighing 150 pounds. The largest unbroken piece was 16 or 18 inches in diameter. On the Umatilla the amount was 25 pounds.

The clinkers are more or less rock-like in appearance varying from a dark gray almost coal-like clinker to a light

gray color, tinged with bluish or greenish or with large light-colored almost white spots or streaks. Mr. Osborne reports one unusual sample having " large blotches of dark blood-red coloring." Sometimes they are rock-like in appearance, other times they are more or less glazed like porcelain. When fresh they can be scratched with a knife or pounded into pieces but are quite hard and glazed. Upon exposure to air they all seem to " slake " and crumble into smaller pieces of a duller appearance. The taste, particularly of the white spots, is one of alkaline bitterness. This is probably due to the abundance of potassium carbonate.

Method of Formation

The method of formation of the clinkers can only be conjectured but certain facts have a bearing.

The length of time of burning seems to be of importance in their formation. The Columbia clinkers were all found only after the snags " had burned for several weeks." The Kaniksu clinkers were formed in snags which were thought to have been burning from the summer of 1926 to the summer of 1927. Mr. Osborne in most cases found the clinkers from a week to three months after a fire. In one case, a large rotten noble fir held fire from August, 1910, to September, 1911, burning down about 125 feet during that time.

Whether wetting of the ash by rain or snow is necessary in causing the formation of the clinkers seems very doubtful. Some cases are known where it is very unlikely that any rain or snow occurred between the fire and the finding of the clinkers. In the Kaniksu case heavy fall rains and winter snows had intervened between the probable beginning of the burning and the finding of the clinkers. The same is true of t Clearwater clinkers, where a rain h put the fire under control and the " mo ping up " process resulted in the findi of the clinkers. On the Columbia rain fell during the period and M Osborne believes other cases to similar.

A seemingly necessary condition is slow, smouldering fire burning in a de cavity where the supply of oxygen m be limited, forming an accumulation ashes which would be fused into a sla like mass by the heat. Whether a limit supply of oxygen is necessary is n known but seems doubtful. An accum lation of ashes apparently is necessa as Mr. Osborne says no clinkers a formed upon the burning of a rotten l lying flat on the ground. The burni in such a case occurs under the same co ditions as those which result in the fo mation of clinkers in an erect snag, th is, rotten wood probably damp or w surrounded by a cylinder of sound sa wood, probably limited oxygen supp but no deep accumulation of ashes abo the actual fire. These logs may burn o hollow for many feet and yet form clinkers. The same is true of a f burning up into the rotten butt of tree. This would point to accumu tion of ash above the fire as the impo tant condition.

In this connection Mr. Blodgett lates the burning of a large " cold deck containing 40 per cent hemlock, on t holdings of the Hama Hama Loggi Company, and the resulting formati of a layer 4 to 8 inches thick of a ha black, lava-like crust covering the grou where the " cold deck " stood. Thou the soil might be involved here, an cumulation of ashes and intense h would also be involved.

In some cases, the fire probably catches on living trees at the conks or the resin flow which is often associated with conks or blind knots (see Hubert *op. cit.*), and burns into the rotten heart of the tree and then slowly downward. It may burn out again at a lower whorl of branches. The burning weakens the tree at the point of entry and the top breaks off, spreading the fire as it falls to the ground and often causing vigorous burning of the snag and consequent " smoking up " which leads to its discovery. Whether this vigorous burning is necessary to fuse the accumulated ash into a clinker seems unlikely as cases are known where such vigorous burning probably did not occur. Minerals probably do not crystallize out in the formation of the clinker, as has been held, but rather there is a fusion of the material brought about by the high temperatures.

In other cases, the fire catches in the broken top of a standing snag and burns downward producing the same result as discussed above. Mr. Osborne believes this to be the most frequent method in District 6.

Relation to Hold-Over Fires

Professor Englis does not believe any chemical reaction in the ash or clinkers would cause a reignition of the tree but that the clinkers are formed incidental to hold-over fires. Mr. Osborne believes this type of rotten snag is the worst type " for holding fire over a long period of time, even under adverse burning conditions." He has observed several of them which held fire from August through very heavy rains of autumn and deep snows of winter and were still smoking in December. The Kaniksu case is even more striking. Smouldering snags were noted on the burned area in October after the vigorous rains of autumn. Mr. Gisborne believes the fire smouldered in a standing tree from July, 1926, to the spring of 1927, and thus was protected from rains and snows. These snags are very difficult to detect as they smoke very little and throw out very few sparks even in windy weather. Their chief danger lies in their falling, splitting open, and thus starting a new fire.

Mr. Osborne claims that rotten wood is usually damp or even wet and the fire burns down slowly drying the rotten wood out only an inch or two ahead of it. In such cases additional wetting from rain or snow might not be of much significance.

Slash and Rotten Logs as a Possible Source of Minerals

It has been suggested that the ash derived from the burning of slash and rotten logs be utilized as a possible source of valuable chemicals. The amount of slash left after logging would undoubtedly be more than enough to supply the demand. The cost of collecting such material and transporting it to the place of burning would probably be greater than the value of the minerals found in the wood. The ash of wood varies from 0.2 to 1.0 per cent, being relatively smaller in conifers than in hardwoods and smaller in heartwood than in sapwood. In this small amount of ash the more valuable chemicals, such as manganese, phosphorous, and magnesium, are present in relatively small quantities. They would undoubtedly be difficult of extraction from the ash.

These factors combined would probably make it economically impracticable to obtain minerals from the wood ash.

THE RÔLE OF SITKA SPRUCE IN THE DEVELOP- MENT OF SECOND GROWTH IN SOUTH- EASTERN ALASKA

By R. F. TAYLOR

Technical Assistant, Tongass National Forest

AN INCREASE in the amount of Sitka spruce in new stands growing on cut-over areas in southeastern Alaska has been long desired. The reasons are largely economic, the preference for spruce resting on its better qualities for lumber and pulpwood. As but 25 per cent of the virgin forest is composed of spruce, the 70 per cent of hemlock is viewed with jaundiced eye, and the praises of spruce resound. To minimize the excellence of those things possessed in great abundance is human nature.

For several years forest research has been under way on a small scale on the Tongass National Forest, which embraces practically all of the timbered areas of southeastern Alaska. As a result of yield studies there now appear to be other reasons for desiring more spruce, reasons based not on supply and demand, but purely on silviculture.

Before dwelling on these reasons, which must be somewhat hypothetical until more data are accumulated, it may be of interest to note that 135 yield plots in normally stocked even-aged stands of spruce and hemlock reveal on the average a much larger percentage of spruce than obtained in the virgin forest; to be exact, 46 per cent by basal area. On most of these areas it is impossible to estimate the composition of the previous stand as the plots range in age from 36 to 154 years and decay has left little eviden One must, therefore, suppose the form cover to approximate the present virg forest with much less spruce. The chan in composition may be explained by t fact that destroying the old stand mov the site backward a little in the ser of successional stages through which proceeds to stability as a climatic clim type. Cut-over areas will be change little as to site, the degree dependi upon the destruction wrought in loggi

The new forests of Glacier Bay g evidence of a heavier spruce cover in t earlier stages of forest succession. H the land was laid bare by glaciation a the new stands have become establish after passing through all the stages o primary succession series. One may vi these stages by traveling from the g ciers at the head of the bay, southwa past the willow thickets, the ald willow-cottonwood thickets intermi with spruce, and finally the young spr forests gradually losing their cottonwo and alder as they increase in age towa the entrance of the bay at Icy Straits. 92 years of age, the approximate ma mum at the bay's mouth, the composit is 92 per cent spruce by basal area.

Although the average of these yi plots runs higher to spruce than the p vious stands, many had a high per c of hemlock, and in almost all cases su hemlock plots were far below the qu

ity of those having a good mixture of spruce.

For some time the writer has been interested in soil conditions as they affect natural reproduction and the development of young stands of timber. The condition of forest soils is naturally an important consideration in our humid climate with its dense coniferous cover. F. R. Weis (1927) aptly declares, "The temperate and cold humid regions, however, presumably present the most numerous and difficult problems for the study of forest soils because *in these localities only are we dealing with one of the most fundamental phenomena in forest soils, i. e., the formation and accumulation of raw humus and the question of the decomposition and treatment of that substance in order to maintain the soil in healthy condition."*

Raw humus exerts its principal effect upon plant growth in its lack of nitrogen. Low soil temperature, lack of aeration, excess of water, and resulting acidity hinder bacterial action, and the return of nitrates to the soil is halted with the formation of ammonia. Furthermore, heavy precipitation tends to leach out what nitrates are formed. The acid humus forms a tough mat over the mineral soil and, besides excluding air from lower layers, hinders root growth.

Such soil conditions are bad for the establishment of reproduction after cutting unless the mat of acid humus is thoroughly broken up. It is contended that raw humus, when aerated and mixed with mineral soil, becomes a rich source of plant food; where it is not so torn up the effect is a slowing up of the establishment of natural reproduction and a large percentage of hemlock in the new stand. Just why the much desired Sitka spruce cannot compete with the more hardy western hemlock on acid soils is not quite clear. Given a rich neutral soil spruce will often persist on most exposed locations, but it seldom survives the first few years on acid soils devoid of nitrates unless in company with leguminous plants or alder.

The action of legumes was shown by Munns,[1] who found that the growth of yellow pine seedlings was materially increased when associated with lupine. Alder exerts a similar beneficial effect by furnishing nitrogen to the seedlings through the action of its nitrogen-fixing root bacteria. It is difficult, however, for alder to become established on acid humus, although it will invade non-acid and mineral soils at once if moisture is available. It often forms a nurse crop for healthy spruce seedlings, as on slides, along streams, and where logging has torn up the ground. The spruce forests at Glacier Bay are no doubt partly caused by the preparation of the soil by the alder. The action of hardwood leaves in improving both texture and reaction of the soil was shown by Perry[2] for such "lime pumpers" as beech, birches, elm, and aspen.

Slow growth and ultimate stagnation are usually the result of the development of stands high in hemlock. Spruce seems unable to live as an understory with hemlock, though the latter will persist many years with spruce in the upper canopy. Neither species does well as a pure stand; the spruce becomes "parky" without hemlock competition, and the hemlock forms stagnant thickets with a thick layer of undecayed litter covering a dense mat of raw humus.

[1] Journal of Forestry, Oct., 1922.

[2] Journal of Forestry, Oct., 1928.

The effect on the quality of second growth stands of varying percentages of spruce is shown in Tables 1 and 2. Table 1 shows 6 plots from Kanalku

TABLE 1

EFFECT OF DIFFERENT AMOUNTS OF SPRUCE IN SECOND GROWTH STANDS, KANALKU BAY, ADMIRALTY ISLAND

Amount of spruce by basal area	Average diameter	Trees per acre	Trees under 8 inches	Site Index [a]
Per cent	*Inches*	*Number*	*Per cent*	
71.7	12.8	352	23.9	140
55.2	12.5	388	17.5	138
39.4	12.0	418	23.9	133½
37.6	9.5	526	42.3	125
32.9	9.0	504	52.6	125
32.4	8.7	550	56.1	127

[a] Site index based on total height of dominant trees at 150 years.

Bay, west coast of Admiralty Island, arranged in descending order of spruce percentage by basal area on an acre basis. It is seen that the plots with a high percentage of spruce have a larger average diameter and a smaller percentage of unmerchantable trees. A high percentage of unmerchantable trees in the plots poor in spruce is reflected in the increased number of trees per acre and consequent lower average diameter. This is due to the persistence of hemlock in the understory.

Table 2 shows a comparison of two groups of plots of approximately 50 years of age and another two groups of a proximately 150 years of age. The f ures are averages of each group on acre basis. It will be seen that the To gass Island group with 40 per ce spruce by basal area has taller tre larger average diameters, and nea twice the volume of the Eagle Riv group. A comparison of the Polk In and Mitchell Bay groups reveals ev more pronounced differences.

In many cases, of course, poor grow of the sort witnessed at Eagle River a Mitchell Bay may be due to poor si but it is the writer's contention th quite often poor site is the direct resu of bad soil and humus conditions duri the reproduction period which becom worse with the development of an almo pure hemlock stand. For example, t Mitchell Bay plots are within a hundr yards of most excellent young stands mixed spruce and hemlock. A simil condition exists at Tongass Island an many other places.

If the hypotheses outlined are corre it will be the task of research to dete mine the best means of preventing sta nant hemlock stands from developing o our cut-over lands. Considering the ec nomic preference, which is a worthy on it seems that the goal should be as hig a percentage of spruce as it is possibl to get without degeneration of the stan

TABLE 2

COMPARISON OF VOLUME AND QUALITY OF STANDS HIGH AND LOW IN SPRUCE MIXTURE

	Amount of spruce by basal area	Basal area per acre	Trees per acre	Height of dominant trees	Diameter of dominant trees	Merchantable volume per acre
	Per cent	*Sq. ft.*	*Number*	*Feet*	*Inches*	*Cu. ft.*
Tongass Island—Age 50	40	282.1	1069	65	13.2	4,642
Eagle River—Age 48	4.8	211.5	1513	62	8.7	2,418
Polk Inlet—Age 150	60.4	317.9	256	127	20.2	15,621
Mitchell Bay—Age 154	27.6	253.5	417	104	14.3	4,920

LIGHT REQUIREMENTS AND SILVICULTURAL PRACTICE

By HARDY L. SHIRLEY

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TRENCHING experiments conducted by Fricke (1) and Toumey (2) have shown that the survival of plants under forest canopies is often determined by other factors than the light conditions. Among these, soil conditions and ground cover appear to be the most important. While these experiments show that the light intensity under such canopies is adequate for the survival of plants, they have not yet given us information as to the rate of growth of the plants under the canopy as compared to similar plants under more favorable light conditions. The relative tolerance of tree species has received a great deal of study in the past, and a number of scales of tolerance have been constructed in a variety of ways. Many of the empirical methods used have failed to differentiate between light requirements and other growth requirements.

In order to study the light requirements alone, the writer has grown a number of species of plants under a range of different light conditions, in cages where temperature and humidity could be controlled. The detailed report of these experiments is being published in another paper (3). It is here proposed to make a comparison of the light conditions of the experiments with those found under natural forest canopies, and thus to interpret the effect of light intensity upon the growth of the vegetation under the forest canopy.

Light Conditions Under Forest Canopies

Measurements of the light intensity under forest canopies show it to be from 0.1 to 20 per cent of full daylight. Under ordinary continuous canopies the light is usually reduced below 10 per cent of full light. Even in "sun flecks" the intensity is seldom more than 20 per cent.

The green leaves change the quality of the light filtering through them to some extent by absorbing more energy in the red and blue than in the green spectral regions. Since the canopy also cuts out a higher percentage of the yellow sunlight than of the blue skylight, only the red region is likely to be deficient.

Light Requirements for Survival

Experiments conducted at New Haven and Yonkers with red, white, and chestnut oaks, loblolly pine, and redwood, together with experiments with a number of herbaceous species, have shown that many plants can survive for a period of from three to six months if they receive as much as 1 per cent of full summer daylight; however, none of the plants used were able to make any appreciable increase in their dry weight at this intensity. A few plants required more light for survival.

Light Requirements for Growth

Since plants are able to survive for a comparatively long time under very low light intensities, the next question is how much more light is needed to produce and maintain healthy, vigorous growth. At this point it is well to consider what is to be used as a measure of growth. A number of investigators have used height measurements and general appearance as indices of growth in light studies. Such methods may be very misleading unless accompanied by measurements of fresh or dry weight, since low light intensities stimulate height growth at the expense of diameter growth, top growth at the expense of root growth, leaf area development at the expense of leaf thick-ness, and succulence at the expense of strength and sturdiness. Data from a number of experiments, of which Figure 1 is typical, show that height growth often increases while dry weight decreases with decreasing light intensity.

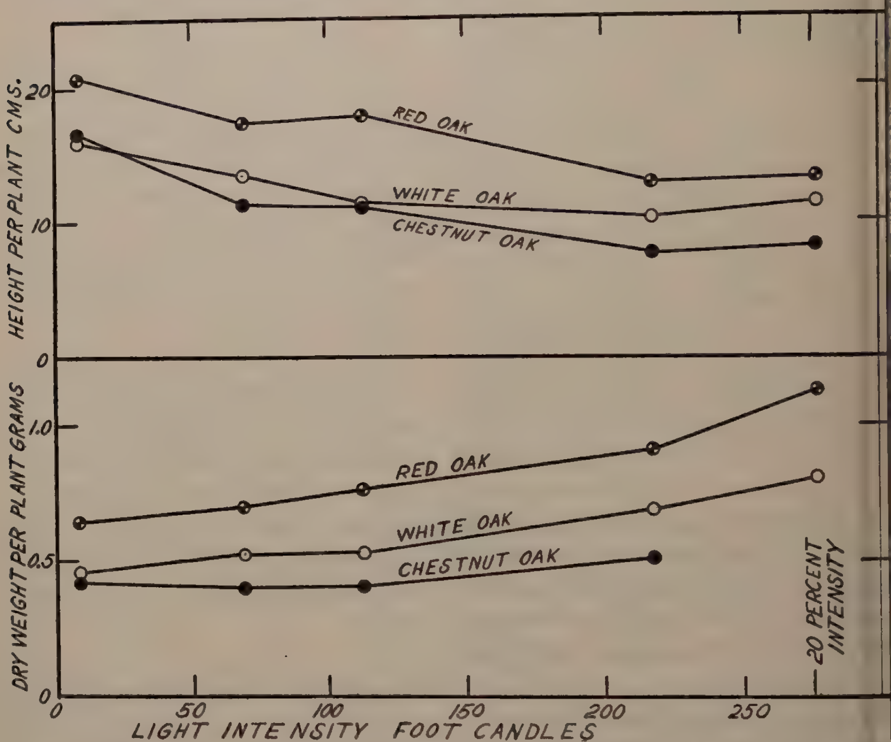

Fig. 1.—Influence of light intensity on the height growth and dry weight of oak seedlings grown at New Haven in the winter of 1926. The tallest plants had the least dry weight in this case.

The total dry matter produced by a plant seems to be one of the most reliable measures of its growth.

The results of experiments with a number of herbaceous and woody plants show that the increase in dry matter produced by the plants is in almost direct proportion to the light intensity they received. (3) Figure 1 is typical of these results; however, here the lar

nount of stored food in the seed allowed e plants grown in very low intensities attain an appreciable dry weight. Iost plants studied produced maximum y matter in full summer daylight. fter increasing the light beyond 20 per nt of full summer sunlight, the growth however, no longer in direct proporon to the light intensity.

Experiments upon the effects of light iality upon the growth of plants have own that plants can grow better witht the red region of the spectrum than ithout the blue, and that the complete lar spectrum seems to be more efficient r growth than any portion of it. It pears, therefore, that the loss in red hich light experiences in passing rough a leafy canopy does not appreably reduce the efficiency of the light r plant growth.

Oaks grown with less than 2 per cent full daylight were considerably deyed in development and failed to rden their tissue until long after those own under higher intensities had prered for winter conditions. Root delopment was always poor under low tensities. The proportion of root to p was almost three times as high for dwood receiving 100 per cent intensity for those receiving 20 per cent inasity.

ELATION TO SILVICULTURAL PRACTICE

It may be concluded from the material esented above that the light intensity der continuous forest canopies is alost always so low as to seriously dease the rate of growth of the under getation, and may often be too low for survival. Light intensities as low as 1 per cent of full daylight may support growth for some time, but are too low to insure survival because of the poor root development, failure to harden tissue, and inability to produce a food reserve under these intensities. Light quality changes under the forest are not likely to have an unfavorable influence on growth.

In the practice of silviculture where it is desired to secure reproduction under an old stand, considerable attention should be paid to the light conditions. From the standpoint of the light needs for the reproduction the fellings should be so arranged that the light intensity during the day seldom falls below 5 per cent of full daylight, and that for two hours or more it should be as high as 30 per cent. The group shelterwood or group selection systems are well adapted for providing these conditions if properly administered. The tree species used in the experiments mentioned were less than one year old. However, experiments with herbaceous plants indicate that these results apply equally well to mature plants. It would seem, therefore, that in the marking of thinnings care should be taken to give ample room to the crowns of the crop trees consistent with securing good bole form and clearing of the lower limbs.

This paper is based on studies made on oaks at Yale University, and on work carried out at the Boyce Thompson Institute for Plant Research. Its purpose is more to emphasize the importance of light in silvicultural operations than to prescribe proper silvicultural procedure. It is felt that similar studies should be conducted for the important crop trees of each forest region before extensive ap-

plications of the results would be advisable.

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USING THE VEGETATION COVER AS AN AID IN STUDYING LOGGED-OFF LANDS AS FOREST SITES[1]

By GEORGE B. RIGG

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THE DISTRIBUTION of many plants is rather sharply limited by the factors of soil ɪd climate. This is so common that e have come to think of certain plants indicators of certain kinds of soil and imate. Thus we recognize that the ɪrious kinds of cactus when occurring ɪturally, without man's aid, indicate a sert, and that a region where Scotch oom runs wild has a good soil and a oderate rainfall and does not have great tremes of either heat or cold. Not ly is the plant an indicator of the mbined character of soil and climate, t within any region in which the mate is fairly uniform it is an inditor of the character of the soil. In neral the plant is an indicator of the aracter of the habitat including all ctors. In addition to the factors of l and climate there are, of course, ny factors due to the presence of ing plants and animals.

Since plants are often good indicators the character of the habitat the term ndicator vegetation" has come into her common use. By this term, as linarily used, we mean plants whose sence in a growing condition gives us ficient indication of the character of habitat so that we may judge whether or not certain other plants can be grown there.

The use of indicator vegetation is a very old practice, and man has for ages been accustomed to making judgments on the basis of it. I have no doubt that all of those present have at some time drawn some conclusions as to what use could be made of certain areas on the basis of the plants that occur there naturally. The conclusion that in the Puget Sound region bottom lands supporting a dense growth of alder trees are capable of producing good agricultural crops is common.

To take a case of a negative instead of a positive indicator plant, we may cite the presence of saltwort, which is characteristic of salt marshes. We know at once that the presence of this plant and of the others that ordinarily accompany it in salt marshes indicates that the habitat, so long as it remains in its natural condition, that is, without drainage and leaching, will not produce agricultural crops. We know this in the Puget Sound region by having seen it tried, and fortunately we know why it is the case. The concentration of the soil solution in such habitats is so high that ordinary crop plants cannot get water enough from the soil to enable them to grow, though there may actually be plenty of water present.

[1] Presented at the meeting of the North ific Section, Society of American Forrs, Seattle, Wash., March 18, 1929.

One more example may be cited as illustrating that the natural occurrence of a single species may give good indication of the value of the habitat for crop plants. The extensive growth of the common stinging nettle is usually believed to indicate conditions of soil and climate which are favorable for the production of garden vegetables, and what experience I have had with this plant indicates that the judgment is correct.

The use of indicator vegetation has been practiced mainly in three lines—agriculture, grazing, and forestry.

Its use in judging the value of habitats for agriculture has been carefully worked out by a number of workers in different regions. One of the most notable of these is the investigation by Shantz of natural vegetation as an indicator of the capabilities of land for crop production in the great plains area of the United States. The results of this study are given in Bulletin 201 of the United States Bureau of Plant Industry. In this area it was the plant community that was found to be the indicator, rather than a single species, but each of the three communities was found to be characterized by the dominance of a single species, and the three habitats are designated as the wire-grass lands, the short-grass lands, and the bunch-grass lands.

His conclusion is that in eastern Colorado the wire-grass association characterized by the dominance of wire grass (*Aristida longiseta*) indicates land with the highest capabilities of crop production year in and year out, while the short-grass lands occupied by the plant association in which short grass (*Bonteloa oligostachya*) is dominant has the largest yield during favorable years but the most frequent failures. The bun grass lands occupied by the plant co munity in which bunch grass (*Ana pogon scoparius*) is dominant, has smallest yield during favorable ye but has the fewest failures. It is possible on the basis of these th readily recognized plant communitie form an accurate and dependable ju ment as to the value of any given for the growth of crops.

Several thorough studies of ra vegetation have been made and it is possible for the expert to predict, on basis of present vegetation, what future capabilities of the range are what forage plants may be most pr ably used. It is not so easy to formu statements on the basis of indic vegetation by which a person not customed to range management judge accurately whether an area is ful for range purposes, and if so, w range plants should be used, but in hands of experts the use of indic plants has come to be a matter of g economic importance.

Indicator vegetation has been more or less by foresters for a long and very definite results have achieved by several workers, espec by Zon and Korstian in the Un States, and by Cajander and Ilvessal Finland.

In a manuscript dealing with i cators of planting sites in Ephraim C yon, Utah, Zon has worked out plant communities that indicate the planting sites for several species of fo trees. The indicator community lodgepole pine consists of a cone flo (*Rudbeckia occidentalis*), mountain rant (*Ribes inebrians*), deer brush (*S*

horicarpos occidentalis), and a species f ninebark (*Physocarpus malvaceus*). Gray's Manual of Botany gives the abitat of the last of these species as "the rocky banks of streams," and of he next to the last as "rocky ground," nd these facts are quite consistent with bservations as to the habitats in which odgepole pine flourishes naturally in the Puget Sound region.

Deer brush is included also in the indicator community for Douglas fir, but he other species—American aspen (*Populus tremuloides*), bush honeyuckle (*Lonicera involucrata*), mountain myrtle (*Pachistima myrserites*), a wild gooseberry (*Ribes sp.*), and mountain elder (*Sambucus microbotrys*)—ndicate in general somewhat better soil and a little more moisture.

The plant community indicating sites ntirely unsuitable for forests consists of a rose bush (*Rosa fendleri*), June berry (*Amelanchier alnifolia*), the piñon pine (*Pinus edulis*), sagebrush (*Artemisia tridentata*), rabbit brush (*Chrysothamnus nauseosus*), a wild apple (*Perophyllum ramosissimum*), and cheat brome grass (*Bromus tectorum*). These in general are plants that, to the botanist, indicate either poor soil or dry conditions, often both.

Indicator vegetation is, of course, not the only means of judging the suitability of a site for a forest, or of deciding what species of forest tree will flourish best in case the site is found suitable for forestation.

A very direct procedure in the case of logged-off lands or burned over areas is to determine by stumps, snags, or occasional remaining living trees what the character of the former forest was and then to reforest with the same species. This method is good in many cases, but not altogether satisfactory if commercial conditions should make it desirable to reforest with some other species than the one that was dominant in the original forest. Also, it is not usable if tables are to be made on the basis of height at a given age because so few trees are left standing.

In the investigations of planting sites in connection with the study of indicator vegetation it has been found, also, that in some cases burning and pasturage have so completely destroyed the remains of the former forest as to leave very little indication of its character.

I recall an extreme case of the complete destruction several years ago of a forest on a large area near Duluth, Minnesota. Here every vestige of the forest was removed and sold for fuel or burned on the spot, and the entire area was planted to wheat. To me the land appeared to be more valuable for forest than for agriculture. The forest in this region varied greatly within short distances, and if the cleared area should be abandoned agriculturally, the vegetation that occupied it naturally may be a valuable indicator of the kind of forest that will prove best to establish on it.

Another method of determining the value of planting sites is by accurate measurement of the various factors of the habitat. These factors may be grouped as (1) soil factors, (2) climatic factors, and (3) factors concerned with the presence of living things (plants and animals). The first and third of these will overlap a good deal because many microscopic organisms, both plant and animal, live in the soil and exert profound influences on the suitability of the soil for the production of a forest.

Many of these factors may be measured accurately. Mechanical and chemical analyses of the soil can be made, and its water-holding capacity, wilting coefficient, and other water relations determined. The general climatic factors for the region are, of course, a matter of record, and local conditions, such as evaporating power of the air, intensity of light, and speed and direction of winds may be accurately measured by instruments.

The factors due to the presence of plants and animals are more complex and more difficult to measure accurately. We may find what bacteria, moulds, protozoans, and other microscopic organisms are present in the soil, as well as what worms and other visible animals; we may list the birds, the rodents, and the grazing and browsing animals that are present; but the mere list of organisms present does not tell us accurately what the effect of any one species will be on a forest, and the net influence of all of the living things is still more difficult to determine.

When we try to combine the effect of these factors due to living things with the factors related to soil and climate, we see that we have a complex and difficult task. Not only is this study of the factors of the habitat time-consuming and expensive, but the interpretation of the data is difficult when we have them.

Experimental planting might be used but this would have to be carried through several years to give any valuable indications, and would yield complete information only when we had watched the development of the forest to maturity.

Observation of natural succession of forest trees and shrubs on the area would, of course, help some, but this involves a study running through several seasons in order to get any useful data.

I have called attention to five possible methods of determining, so far as possible, whether any given site is suitable for forestation at all, and if so what species will be most productive. These are: (1) Observation of the remains of the preëxisting forest; (2) measurement of the factors of the habitat due to soil, climate, and living organisms; (3) experimental planting; (4) observation of natural succession; and (5) the use of indicator vegetation. All of these means have their useful phases and their limitations, but I have great faith in the use of indicator vegetation, and in justification of this faith I wish to point out the definite results that have been obtained in two studies of the forests of Finland by this method. Many studies have been carried on in the United States besides those of Zon cited above, but the work of Cajander and Ilvessalo on the forests of Finland has been so thorough and carried through so many years as to be especially valuable.[3]

Cajander is Director General of the State Department of Forestry in Finland. I have the citations of 29 papers on the forests of his country published by him from 1902 to 1926, and am basing my discussion of his work on the last of these—a paper of 108 pages entitled "The Theory of Forest Types," published in England in the Publications of the Society of Forestry in Finland.

In this work he describes six forest classes, basing each class on the vegeta-

[3] The work of Raunkiaer, a Danish botanist, on "Life Forms," also contains material that should be of use to foresters. See Journal of Ecology, Vol. I, pp. 16-26, 1913; also McDougall's Plant Ecology, pp. 200-204.

tion, other than the dominant trees in the forest, which is present when the stand is mature and normally developed. It is to be noted that this is slightly different from judging forest sites on the basis of the vegetation present in logged-off lands. There will, of course, be some differences between the vegetation that will grow in the forest and after the forest is removed, because of differences in shade, in the evaporating power of the air around the leaves, and in the rate of evaporation of water from the soil surface. If burning has been excessive this will also have its influence, since much of the humus will be destroyed and the large amount of ash may lower the acidity of the soil. Many plants characteristic of the forest tend, however, either to persist after the removal of the forest or to reëstablish themselves in a short time.

It seems evident that too little attention has usually been paid to the vegetation other than forest trees on possible forest sites, and undoubtedly more attention will be given to it in the near future. Unquestionably, the study of the vegetation occurring naturally on logged-off lands, and the study of the shrubs, herbs, ferns, mosses, and lichens of the mature forest should go hand in hand and the best results will be reached by a full understanding of both.

Cajander's six classes are: (1) The dry moss- and lichen-forest class; (2) the moist-moss-forest class; (3) the grass-herb-forest class; (4) the huckleberry-gooseberry-currant-forest class; (5) the spruce and broadleaf tree-forest class; and (6) the pine-peat moor-forest class. For the purpose of clearness of discussion in a brief presentation such as this I have called all six of these "classes," though Cajander calls the last three "types" and divides each of the first three into several types. My treatment does no violence to the essential ideas that he presents.

Cajander points out that in addition to these six classes there are varying types of forest that occur on lands inundated by rivers, or blown sand, on rocky ground, at the forest limit on mountains, and in the vicinity of tundras. These, he says, are of local significance.

In order to make the discussion definite it will be well to give under each of Cajander's six classes a statement about the forest trees, the other vegetation, and the character of the humus.

In the first of these classes the vegetation is distinctly characteristic of dry habitats. Lichens are nearly always present and in the driest places form a continuous cover. The moss vegetation is in almost inverse ratio to the lichen vegetation. Herbs and grasses are scarce. Dwarf shrubs are rather plentiful and are mostly such as characterize dry habitats. Few bushes occur—mostly a juniper and some willows. The humus is thin and in the driest places is almost entirely lacking. The forest in which this class of vegetation grows is mostly Scotch pine, with occasionally a few other trees.

In the second of these classes the vegetation is such as to indicate a dry habitat but one not quite so dry as the first class. The moss vegetation is fairly abundant and continuous and the lichens are scarce. Herbs and grasses are more abundant than in the first class and dwarf shrubs are fairly plentiful. The humus layer is well developed but mostly raw. The forest is mostly spruce (*Picea*

excelsa), birch (*B. verrucosa* and *B. odorata*) and Scotch pine (*P. sylvestris*).

In the third of these classes the vegetation indicates a much moister habitat. Grasses and herbs are abundant, the species are numerous, and the presence of thin-leaved species is very noticeable. Ordinary shrubs are fairly abundant, but dwarf shrubs are very scarce. Moss vegetation is scanty, though consisting of many species, and lichens are very scarce. The humus is thick and well decomposed. The forest is mostly of hardwood trees with light seeds and Norway spruce. Scotch pine usually does not occur as a forest-forming tree.

The fourth class, characterized by huckleberries, gooseberries, and currants, is a transition between the dry moss- and lichen-class and the grass-herb class. Its distribution is limited and it occurs mostly on higher slopes.

In the fifth class the vegetation is such as to indicate a fairly wet or even very wet habitat. Several species of peat moss and other mosses of fairly wet places are abundant. The land is boggy and the forest is mostly Norway spruce or broadleaf trees. Scotch pine is negligible.

In the sixth class the vegetation in general indicates a habitat in which the vegetation is such as we would expect to find in dry places, though the land is boggy and is really wet. The surface of the substratum is mostly formed of peat moss and other mosses. The Scotch pine is most abundant, though Norway spruce and birch occur.

The English summary of Ilvessalo's 1927 publication consists largely of details about the forests of Finland based on the classes established by Cajander. He groups the areas as: (1) Productive forest lands; (2) forest lands of poor growth; (3) waste lands; and (4) cultivated lands, including forests used for pasturage. He includes under productive forest lands all of Cajander's first three classes, and part of his last three. He points out also specific differences between forests occurring on peat lands and those occurring on firm lands. His report is a detailed analysis of the economic value of the forests indicated by Cajander's six classes.

The silvicultural conditions found in the investigation have been published separately by one of his co-workers, O. J. Heikenheimo, director of the Forest Research Institute.

We come now to the application to the Puget Sound Region of the indicator vegetation method of judging forest sites. It has not been tried here, and presents to the scientific mind the attractiveness always found in an excursion into the unknown. Ilvessalo has visited our region and has expressed the opinion that, although our conditions are quite different from those found in Finland, the method could be successfully applied here.

During the 22 years of my delightful experience in studying the vegetation of the Puget Sound region and Alaska I have seen many things that fit well into the general scheme used by Zon and others elsewhere in the United States, and by Cajander, Ilvessalo and other workers in Europe, and many other things which, while not fitting so definitely into the scheme, are at least suggestive of definite problems for investigation.

Among the more definite situations seen are:

1. The general similarity of the plant communities of portions of the Alaska

coast regions, especially toward the limits of the forests on the Alaska peninsula, to the habitats of Cajander's first and second classes. The Alaska forests on these habitats consist of an almost pure stand of spruce which in a number of places is being utilized.

2. The occurrence in the Puget Sound region of fairly good forests on sites whose vegetation seems to be somewhat between Cajander's first and second classes. An example of this is a fairly good mature Douglas fir forest in local areas in the Dosewallips Valley in the Olympic National Forest, where in the neighboring regions the forest is better and the habitat is more like Cajander's fourth class. Other similar examples are found on San Juan and Orcas Islands in the San Juan group.

3. Forest succession on sphagnum bogs. There is a general tendency for forest succession to come naturally on mature sphagnum bogs with hemlock as the first and most successful invader and Douglas fir as the last and least successful invader, with cedar occupying an intermediate position. In certain cases, however, lodgepole pine has been the principal invader, and in others the western white pine. In one case near Victoria, B. C., a good young forest of a practically pure stand of lodgepole pine has developed on a sphagnum bog with a dense undergrowth of Labrador tea, a characteristic bog plant. In the forests of Skagit and Whatcom counties in Washington the western birch, a tree of considerable economic importance, is a remarkably successful invader of mature bogs, especially where they have been burned. In the Seattle region the peat bog birch, a shrubby species of no commercial value, is common in spaghnum bogs.

4. The dominance of such erect shrubs as sticky balm and manzanita (*Arctostaphylos tomentosa*) and the prostrate shrub kinnikinnick in many places on gravelly hills where the Douglas fir is sparse and poorly developed and there is some lodgepole pine and western white pine showing better development. The region in Kitsap County, Washington, and certain areas near Covington, Washington, and some of the area east of Lake Washington, opposite to Seattle, are good examples of this. These plants are not only characteristic of the forest but they survive in the logged-off lands.

5. The ferns and wood sorrel (*Oxalis trillifolia*) which cover the soil in the rich coniferous forests of the western slopes of the Olympic mountains, and strongly suggest one of Cajander's types.

It seems to me that a good starting point for a study of indicator vegetation in the Puget Sound region would be a study of the occurrence of 12 species—Madrona (*Arbutus menziesii*), sticky balm, manzanita, kinnikinnick (*Arctostaphylos uva-ursi*), mountain box (*Pachistima*), evergreen huckleberry, red huckleberry, trembling aspen, Labrador tea (*Ledum*), bracken fern, and skunk cabbage. Vegetation groups which should be studied are mosses, lichens, and ferns.

These are suggestions for the beginning of a study that should be carried on jointly by foresters and botanists. If widened to include all of the vegetation found in the region it would, I believe, prove of great value in classifying lands as agricultural lands, waste lands, and forest lands, and in indicating what kinds of forest are best on the various sites that are suitable for forests.

A STUDY OF THE ROOTS IN A SQUARE YARD OF JACK PINE FOREST[1]

By E. G. CHEYNEY

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THE MASS of roots encountered in a study of the root system of a single hazel bush piqued the writer's curiosity to know something about the root systems of other forest plants, more especially the quantity of roots of all kinds present in the forest soil. Accordingly, a plot 3 feet square was laid off in a patch of jack pine timber in Itasca State Park in northern Minnesota to study the roots found in the upper 18 inches of soil.

The plot was located on the brow of a hill, about 150 feet from the edge of a tamarack swamp and about 15 to 20 feet above the level of the swamp. The jack pine stand had a density of about 6. It was composed of a mixture of jack pine and white spruce. The nearest trees to the plot were an 8-inch jack pine 6 feet to the south and a 5-inch white spruce 11 feet to the southeast. About 15 feet to the north was another jack pine.

The number of plants in the plot and the total length of the roots by species is shown in Table I.

The plot was sub-divided into 6-inch squares by means of cord. The plants in these 36 squares were then identified, with the aid of Professor C. O. Rosendahl, of the University of Minnesota, and carefully mapped. Patches of Hypnum moss, covering in the aggregate about 20 per cent of the plot, were ignored altogether.

There were on the square yard plot 318 plants, including 27 species, and it must be remembered that this is in a jack pine forest where vegetation is apparently sparse. As the writer was unfamiliar with the appearance of the roots of many of these species, it was impossible to start digging at the boundary of the plot. Such a method would have cut off many roots which originated outside of the plot and could not then be identified. Excavation was, therefore, started outside of the plot and the roots were traced in from the plants. They were later cut off at the boundary line when identification was certain.

A hole 3 feet deep was dug on the east side of the plot and about 1 foot from it. The soil was a coarse sand and was readily washed down by a small stream of water. A small 3-gallon hand sprayer was found very effective and was used throughout the work.

It was found most convenient to work from below upward. The half inch of litter and Hypnum moss, which formed quite a tough layer on the surface of the ground, was first removed and then the dirt was washed from the roots from below with the sprayer. The stream of water was so small and the source of the water so far away that progress was

[1] Published with the approval of the Director as Paper No. 198 of the Miscellaneous Series of the Minn. Agric. Experiment Sta.

TABLE I

LENGTH OF ROOTS IN A SQUARE YARD OF JACK PINE FOREST

Common name	Scientific name	Number of plants	Length of roots in inches
Anemone [a]	Anemone quinquefolia	4	....
Aster [b]	Aster azureus	10	1,216
Aster [b]	Aster sp.		
Awned wheat grass [c]	Agropyron caninum	3	....
Balsam [a]	Abies balsamea	1	....
Bearberry [d]	Arctostaphylos uva-ursi	0	57
Bedstraw [a] (northern)	Galium boreale	1	....
Blueberry	Vaccinium pennsylvanicum	19	4,618
Bracken fern	Pteris boreale	3	626
Choke cherry [a]	Prunus virginiana	1	....
Columbine [a]	Aquilegia canadensis	2	....
Cornel	Cornus canadensis	18	1,431
Cow wheat [c]	Melampyrum lineare	2	....
False lily-of-the-valley	Unifolium canadense	54	1,644
Goldenrod [d]	Solidago, sp.	0	26
Grass [c]		..	406
Hawkweed	Hieracium sp.	6	68
Honeysuckle	Diervilla lonicera	34	3,587
Jack pine [d]	Pinus banksiana	0	11,304
Juneberry	Amelanchier sanguinea	1	175
Ladies tobacco	Antennaria canadensis	54	849
Largeleaf aster [b]	Aster macrophyllus	18	....
Lousewort	Pedicularis aquilina	6	71
Meadow rue [a]	Thalictrum dasycarpum	3	....
Oatgrass [c]	Danthonia spicata	29	....
Pea vine	Lathyrus ochroleucus	2	84
Ragwort [a]	Senecio balsamitae	1	....
Rosebush	Rosa blanda	3	236
Spurred gentian [a]	Halenia deflexa	5	....
Strawberry	Fragaria virginiana	17	1,734
Twinflower	Linnaea borealis	20	167
Violet [a]	Viola conspersa	1	....
White spruce [d]	Picea glauca	0	3,646
Miscellaneous		..	1,884
Total		318	33,829 inches or 2,819 feet

[a] Identity lost—classed as miscellaneous.
[b] Two species of Aster combined.
[c] All grasses thrown into 1 class.
[d] Plants outside boundary but roots entered plot.

very slow, but comparatively few of the roots were broken.

As soon as a plant was completely washed out it was placed between the leaves of an old magazine and its species and page were marked on the cover. This was found to be a very convenient filing system. When the tangle of roots became so great as to interfere seriously with the work, sections of known roots were cut off and filed in the same way, care being taken not to leave in the ground any branches which could not be identified later.

Even with all this care, some roots were unavoidably broken in handling the tangled masses and the identity of others lost. The unknown pieces were placed in a miscellaneous class and aggregated almost 1900 inches, a considerable quantity, but after all a rather small proportion of the total root length.

By far the greater part of the roots are in the upper 6 inches of soil. The roots of lousewort, grasses, strawberries, aster, twin flower, false lily-of-the-valley, ladies tobacco, dwarf dogwood, and bearberry are almost entirely within the first 6 inches. The roots of the others are very largely in the next foot of soil. The Juneberry, the choke cherry, and the rose bush are the only ones which go much beyond a depth of 18 inches. The root of the rose bush penetrated deeper than 3 feet.

Many of the "plants" are only shoots from a very extensive underground root system. In the case of the dwarf dogwood, the largeleaf aster, and the false lily-of-the-valley one receives the impression that all the plants in the woods must be attached to the same root system.

A very great part of the total root length is found in the mats of fibrous roots on the ends of the running, lateral roots of such plants as spruce, jack pine, blueberry, and honeysuckle. These sometimes attain a density which makes them resemble a fiber mat or a worn scrub rag.

The nearest spruce tree, for example, was 11 feet from the plot. A root nowhere more than a half inch in diameter extended the whole 11 feet, within an inch of the surface and without a single branch, but within the plot this root branched several times. The branches dropped to a depth of a foot or more and the fibrous ends produced a total length of almost a hundred yards.

The tendency of plant roots to follow old root channels has been noted by many European investigators. It was noted here in several instances, especially in the case of the vertical spruce and jack pine roots. In several cases the new root had grown through the old root, lengthwise, and still retained the bark of the old root like a loose outer casing or sheath. A new root is probably led to follow such a course wherever possible by the greater opportunity for an abundant food supply, a greater supply of water, and an easier passage through the soil.

The length of all of the roots dug from the plot was measured down to a tenth of an inch and recorded by species. It would undoubtedly be more interesting to have them classified by depth zones, but that would have required much more time and a far greater knowledge of the roots than the writer possessed. Even as it was, the digging alone occupied all the writer's spare time for five weeks, probably the equivalent of a week of full time work.

It is, of course, realized that all the root hairs and probably very many short

pieces of fibrous roots (broken off in the digging) have been left out of consideration. The actual root length would be much higher than that obtained in this study.

It is hard to say just what significance may be attached to this total length of roots. Undoubtedly much of this length is inactive, how much was not determined. It might have been possible to determine the total volume of the roots with more or less accuracy, or to get their oven-dry weight, but the writer cannot yet see any more significance to the volume or weight than to the length. Some possible application of this knowledge may be discovered later.

Just what these roots are doing there in the soil, how much moisture and food they are taking out, how much organic substance their decay puts in, and just how their presence may aid or hinder each other, all these things may be determined some day. In the meanwhile, the knowledge of the mere presence of such a tremendous quantity of roots in the forest soil is a great stimulus to further study.

It would be interesting for the forester to know what effect this tangled mass of roots has upon the establishment of young seedlings which must draw their nourishment from this upper 6 inches of soil. The competition for food and moisture must be fierce and unrelenting. It is quite possible that this competition is often the deciding factor in the failure of reproduction to establish itself, but much more study is necessary before this can be definitely determined.

A SLIDING SCALE FOR HEIGHT MEASUREMENTS

By RICHARD D. STEVENS
Yale School of Forestry

IN THE summer of 1928 at the Yale Demonstration and Research Forest, Keene, N. H., it became necessary to measure a considerable number of tree heights, varying from seedlings to trees sixteen or seventeen feet tall. Not only was it necessary to measure the total heights but also the annual height growth of each tree for the previous five years. Two men were required for the measurement of the taller trees and a simple ten-foot measuring stick, graduated in inches, was used at first. It soon developed that this was a very slow process and cut down the efficiency considerably. To speed up the work, a sliding rule was devised by the author and W. E. White, with the scales so arranged as to give direct readings with a check for each one.

In principle the new rule is simply an extension rod working in the same manner as a levelling rod. However, the scales were placed in such a way that the total height could be read directly by the man operating the rule. The annual growths in inches could be read by the assistant and checked by the operator after each reading.

The instrument was marked and put together at the forest. Two strips of spruce were used, each five-sixteenths of an inch thick and one inch wide. One of them was eight and the other eight and one-half feet in length. These were given two coats of white paint and were marked off in feet and inches, using a small cold chisel in marking the gradations. The cold chisel edge was found to be of about the sharpness required to properly mark the scales. The numbers were stamped on with small metal stamps. The inch marks and the numbers on the main scales were inked with black india ink. The other scales were colored with red india ink and the rule given a coat of shellac.

A small strip of brass was used for the guides which were put on in the usual manner. The two parts of the sliding rule were put together so that one face gave the total height reading from the bottom up, and the other face gave the total height reading from the top down. A small screw with a large head was put in the side of each stick to keep it from sliding through the guides and coming apart.

The outside face of rod I bears a scale (scale 1 in Figure 1) reading from the bottom up in feet and inches, and another (scale 2 in Figure 1), 72 inches in length which reads in inches from the bottom. Both of these scales are used separately on the smaller trees; the first to measure total heights, the second to measure annual heights.

The inside face of rod I has one scale (scale 3 in Figure 1) beginning at the lower end at eight feet and marked off in feet and inches up to sixteen feet. This is for measuring the total heights of the taller trees when the rule has to be extended. The other scale (scale 4 in Fig-

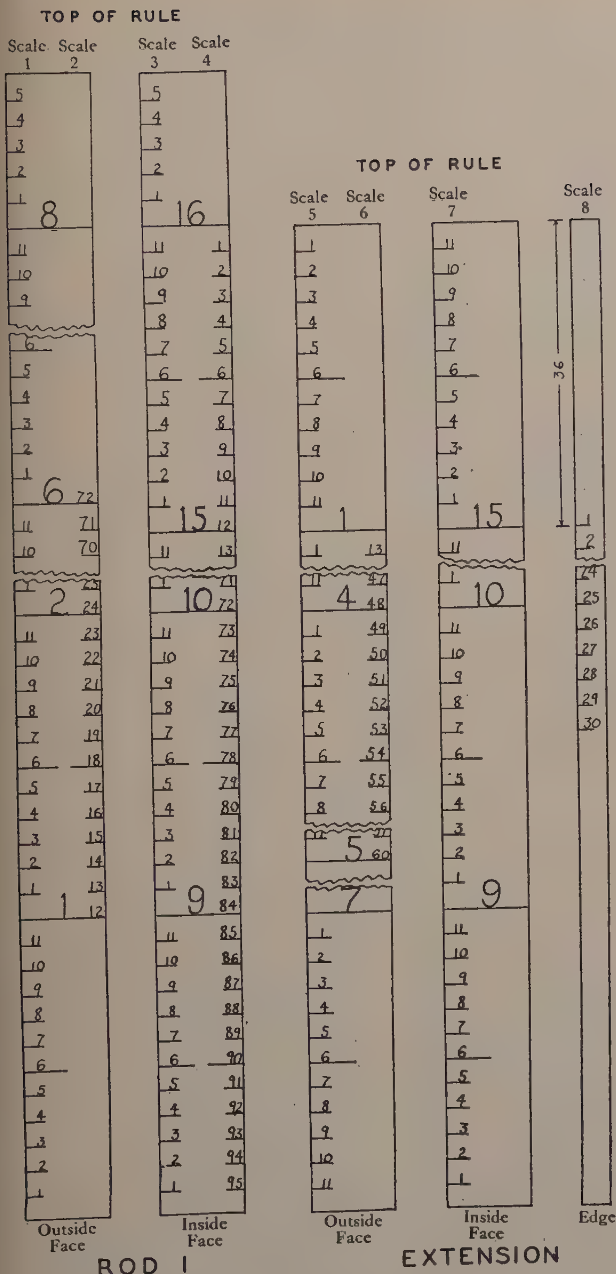

FIGURE 1.

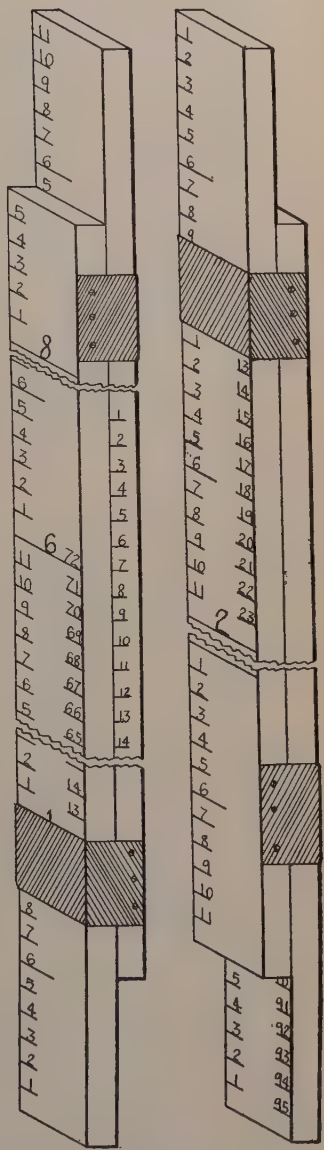

FIGURE 2.

ure 1) on this face starts at the top and is divided into inches, numbered from 1 to 96. This is used when measurements in inches are desired.

There are also four scales on the extension. On the outside face, scale 5 (Figure 1) is in feet and inches from the top of the rule down and is used when measurements are to be taken from that end, e. g. the total height growth for the previous five-year period. Scale 6 (Figure 1) is the same but is in inches only and is used for measuring the annual growths by the assistant.

On the inside face, scale 7 (Figure 1) is marked in feet and inches from the bottom up, beginning at nine feet and running up to sixteen. This is an extension of scale 1 on the outside face of rod I and is used for measuring total heights with the rod fully extended. Scale 8 (Figure 1) is an inch rule on the edge of the extension and is used for measuring annual height growths which fall below the top of the rule when it is closed.

Two men operate the rule, one at the tree and one a little distance away to read and tabulate the results. The operator stands at the base of the tree with the lower part of rod I firmly on the ground where it is kept for all of the measurements. He raises the extension to the top of the tree as determined by the other man. A field glass may be used for more accurate adjustments. When the assistant finds that the top of the extension is at the same height as the tip of the tree, the operator calls off the height as read at the bottom of the extension from scale 3 on the inside face of rod I. Then the assistant reads the length of the tree leader in inches on scale 6, which is on the outside face of the extension, and the operator lowers the extension that number of inches, so that the top of the rule should be at the starting point for the measurement of the next annual growth. If this checks on the whorl, the reading is correct and the rest of the annual height growths are measured and checked in the same way.

In case the annual growth to be measured falls below the top of the closed rule, another scale is used. The extension is raised until scale 8, on the edge, is in place and the height growth is read by the assistant.

Examples will illustrate the two cases. A tree 15 feet and 3 inches is to be measured for total height and for the annual height growths for the preceding five years. The operator extends his rod and adjusts it as the assistant directs and reads off, " fifteen feet and three inches." The assistant notes the total height and his own reading for the leader length. This length he calls off to the operator as, " twenty-five inches." The operator lowers his extension 25 inches and the assistant checks the top with the whorl at the base of the leader; calls off the next reading, " twenty inches," which the operator checks with his rule; and so on until the last reading is taken and checked. Ordinarily the five measurements can be taken without the rule becoming completely closed.

As a second example, we have a tree eleven feet high with the same measurements to be made. The operator calls off his total height, " eleven feet "; the assistant calls his reading, " thirteen inches," which is checked; " ten inches," which is checked; " seven inches," which is checked; and " twelve inches," which falls below the closed length of the rule

and, therefore, cannot be checked in the usual manner. Here the operator raises his extension 24 inches when the zero point on the edge scale (8) should coincide with the fourth whorl to check the fourth annual reading. Then the last reading is taken and is checked on the edge scale.

The distance for raising the rod in this check is arrived at as follows. The zero mark of scale 8 lies at a point 36 inches from the top of the extension, so the distance to raise the rule is simply 36 minus the last reading, which in this case was 12, or 24 inches. If the fourth annual height growth reading had been 20 inches, the extension would have been raised 36 minus 20 or 16 inches. As a check on the measurement, the zero point of scale 8 should then coincide with the lower whorl of the last yearly height growth measured.

With a little practice one becomes very proficient at lowering or raising the extension the required amount for the check and the measurements. The rule is light, strong, and comparatively easy to make and to carry in sample plot work. When all of the trees are less than eight feet in height, the two parts may be separated and only the rod I used.

Figure 1 shows the details of marking the two parts. Figure 2 shows the parts assembled and ready for use.

The Molecular Structure of the Cell Wall of Fibers. A Summary of X-Ray Investigations.

Prof. O. L. Spousler, forester and botanist, has been engaged since 1922 at the University of California at Los Angeles in fundamental organomolecular investigations of great importance to those interested in wood. The results of his work are summarized here in the form of abbreviated extracts from the following publications. The original articles give a better conception of the subject not only because of their more extensive treatment but because they are copiously illustrated. The space lattice models, especially, make it possible for one who is not a physicist to comprehend what is otherwise, necessarily, a highly technical subject:

Sponsler, O. L. The structure of the starch grain. Amer. Jour. Bot. 9: 471-492. 1922.

———. X-ray diffraction patterns from plant fibers. Jour. Gen. Physiol. 9: 221-233. 1925.

———. Molecular structure of plant fibers determined by X-rays. Jour. Gen. Physiol. 9: 677-695. 1926.

———. The cellulose space lattice of plant fibers. Nature 120: 767. 1927.

———. The molecular structure of the cell wall of fibers. Amer. Jour. Bot. 15: 525-536. 1928.

———, and W. H. Dore. The structure of ramie cellulose as derived from X-ray data. Colloid Symposium Monograph 4: 174-202. 1926.

——— and ———. The structure of mercerized cellulose. Jour. Amer. Chem. Soc. 50: 1940-1950. 1928.

During the past decade a method of studying atomic and molecular structures, physically, has been developed which is based upon the diffraction of X-rays from layers of atoms. It has been applied to many substances, especially to crystalline materials, and through its use enormous strides have been made in gaining a clearer insight into their structure. The same method has now been used to study the structure of the less obviously crystalline material of the cell wall in order to determine, if possible, the kind and arrangement of its molecular components.

The procedure was as follows:

Plant fibers were subjected to X-rays in an appropriate apparatus, and were found to produce lines on a photographic film. These lines, which form what is called a *diffraction pattern,* were interpreted as representing a space lattice. The unit of that lattice was then studied in connection with the $C_6H_{10}O_5$ group. Models of C_6 groups were constructed to scale and built into the form of a lattice. They were then studied in more detail in an attempt to reconcile the chemists' data with the X-ray data. Studies of phenomena of swelling and of certain physical properties of fibers were made in connection with the structure that had been developed.

The results of these studies are:

1. X-ray diffraction patterns prove the existence of structural units in the cell wall of ramie fibers.

2. They prove that these units have a regular arrangement in layers in the wall; that the layers are uniformly spaced; and that some of the layers extend lengthwise of the fiber and some crosswise at various angles.

3. From the patterns, the distances between the layers of the various sets of layers were computed.

4. The data obtained made it possible to construct a space lattice from which the dimensions of the structural unit were determined.

5. The unit was shown to be, with a very high degree of probability, a $C_6H_{10}O_5$ anhydro-glucose residue.

6. Evidence from the X-ray patterns, from cellulose chemistry, and from the models of the structural unit, makes it seem very probable that the units are attached in chains of indefinite length.

7. A summation of all the evidence indicates clearly that the structural units are $C_6H_{10}O_5$ groups attached into chains which extend lengthwise of the fiber, parallel to one another, and very uniformly spaced.

8. This structure is in agreement with all of the properties and reactions of cellulose fibers so far considered.

These results were obtained by using several different kinds of fibers and cells. The work was carried on in greatest detail with bast fibers of ramie (*Boehmeria nivea*); in much less detail with hemp, flax, and spruce fibers and cotton hairs; and only in an exploratory way with the more iso-diametric cells such as those of pith. The conclusions arrived at, then, must apply specifically to the ramie fibers. Other fibers seem to have the same structure, but as yet that has not been demonstrated with certainty. Practically nothing can be said of the wall structure of any other cells than those of the elongated fiber type.

There are several points concerning the method involved which should be understood. A layer of atoms or molecules, such as exists on the face of a crystal, reflects X-rays somewhat as it reflects visible light, except that only a very small amount of the X-ray beam is reflected from the surface layer. The greater part of the beam passes on into the crystal where each layer parallel to the surface reflects an equally small amount. When there are a sufficiently large number of layers to make the sum of all their reflections an appreciable amount, a diffraction line is possible. Not only must the *number* of layers be large, in the thousands usually, but they must be *parallel* and the *distance* between every two must be the same. When those three conditions are fulfilled the layers are capable of producing *one* line of a diffraction pattern. Another face of the crystal may have as *many parallel* layers beneath it, but the *distance* between the layers may be different from that of the crystal face just considered; these layers then are also capable of producing *one* diffraction line, but that line would have a different position in the pattern. In other words every line of the diffraction pattern corresponds to its *own* set of parallel layers which have a very *definite distance* between them.

Diffraction patterns obtained from the ramie fibers had over thirty definitely measurable lines. That proved directly that the *atoms or molecules are arranged in parallel layers, in many sets of layers which have different spacings.* It was readily demonstrated, by turning the bundle of fibers to different known posi-

tions, (*a*) *that certain sets of layers extended lengthwise of the fibers,* (*b*) *that other sets of layers extended across the fiber wall at right angles to the lengthwise layers,* and (*c*) *that still other sets formed definitely determined angles with lengthwise layers.* The only conclusion allowable in the present state of knowledge is that structural units of some kind form a space lattice in the wall of the fiber.

If it were possible to magnify a fragment of a cell wall many thousand times, enough so that the constituent " building bricks " or structural units would become visible, each unit would appear as an irregular group of atoms. In a sense the *X*-ray method makes it possible to do this and to make the structural units visible, but visible to the mind rather than visible to the eye.

This irregular group of atoms resembles a glucose molecule in that the former is a $C_6H_{10}O_5$ group and the latter $C_6H_{12}O_6$. The location of the atoms within these groups is very much the same in both cases. While it is necessary to keep in mind the conception of the molecule as a group of about twenty atoms, it is extremely convenient to think of it as a unit in itself, with a definite although irregular shape, having length, breadth, and thickness, or at least having space allotted to it in three dimensions. We need not be concerned about the structure of the constituent atoms, but may consider them merely as particles which are called carbon atoms, oxygen atoms, and hydrogen atoms and which are recognized as occupying space and having weight. This group, $C_6H_{10}O_5$, having definite dimensions and weight, may be thought of as a structural unit which keeps its shape, size, and weight wherever it is found in the cell wall, just as an ordinary brick remains the same regardless of where it is placed or how it is oriented in a brick wall.

If magnified many thousand times, this group would appear to be attached to similar groups to form a long chain. The chains themselves are laid parallel to one another and extend lengthwise of the fiber, forming layer after layer, quite uniformly spaced, from the outer to the inner surface of the cell wall. The distance between these parallel chains is very uniform, although very small. It must be realized that such distances are far below microscopic visibility and that a chain having 2000 of these structural units in its length would be only one micron long. The smallest particle visible in the microscope would contain a very great number of these $C_6H_{10}O_5$ groups.

The chains may be thought of as extending the full length of the fiber, all parallel with and separated from one another by uniform distances. One layer of these chains may be considered as forming the outside layer of the fiber wall, thus becoming more or less cylindrical; another layer or cylinder as occurring just inside this, a third cylinder inside the second, and so on, cylinder inside of cylinder concentrically making the wall several thousand cylinders thick. The chains are arranged to form radial layers, as well as tangential layers. If we think of both these sets of layers as occurring vertically, then there are horizontal layers also.

This structure, with layers in its three different dimensions, is called a *space lattice.*

Each unit of the lattice has allotted to it a certain amount of space which is

called here, for the time being, the *elementary cell*. The volume of this space is $5.15 \times 5.40 \times 6.10 = 169$ cu. Å. u., as computed from the distances between the layers. This, then, is the volume of the group of atoms which acts as the unit of the lattice. According to the cellulose chemist that group is the anhydro-glucose residue, $C_6H_{10}O_5$, which should have a volume equal to that of the elementary cell. It is possible to test out this requirement.

The volume of the $C_6H_{10}O_5$ group as it occurs in a cellulose fiber bears a definite relation (*a*) to its molecular weight, (*b*) to its specific gravity, and (*c*) to the Avogadro number. All three of these are known or are readily obtainable, and from them the volume of the unit group has been determined. It is 170 cu. Å. u. This compares so favorably with the volume of the unit of the lattice, 169 cu. Å. u., that it seems highly probable that the chemists' C_6 group and the structural unit determined by X-ray methods are identical.

In order to determine the dimensions of the $C_6H_{10}O_5$ group, the chemists' data were very carefully studied and the position of the atoms within the group with respect to one another, which seemed to fit the evidence best was selected as a pattern from which to construct a model of the group. Atomic diameters were obtained from the works of various investigators on crystal structure, and a large model was made to scale. This model was an excellent fit in the elementary cell of the lattice. What was still more striking was that it would fit in only one position and that position was the one which seemed to be demanded by the X-ray data.

When attempting to fit it into the elementary cell it was found that the units fit closely together lengthwise of the fiber. That would permit the formation of chains of indefinite length. From the lattice it would seem that these groups could be attached to one another laterally as well as vertically, but the X-ray data indicate very strongly that if there is any attachment it must be into vertical chains. The chemists are fairly well agreed that the units are linked to one another in some way, and that they are linked through an oxygen atom to certain definite carbon atoms which have been numbered 1 and 4. It happens that these two carbon atoms are exactly opposite each other, which makes it possible for the units to become linked together into straight chains and to form a structure such as we have indicated.

There seems to be a fairly clear correlation between the forces existing in three directions in the lattice and the strength values, swelling properties, and thermal expansion values in three directions in the fiber. The primary valence bonds which hold the groups into a chain would make for greater strength lengthwise of the fiber than would the secondary valences which hold the chains to one another laterally. The fiber could swell laterally much more than longitudinally if it could swell at all in the longitudinal direction. Molecular agitation, which is associated directly with the coefficient of thermal expansion, would be greater laterally than lengthwise of the fiber. Data concerning these three properties are in good agreement with the lattice structure, at least qualitatively. Up to the present time no attempt has been made to show a quantitative relation.

The chain structure seems to account also for certain observations in the

chemistry of cellulose and in the mercerization of cellulose fibers. It explains why certain addition products of cellulose may be formed without altering the fiber appearance; and why, when other esters are formed, the fiber disintegrates or goes into solution. In the process of mercerization, X-ray spectra show that the chains have been moved bodily to slightly different positions. The movement seems to be a lateral shift of the chains in such a way that after the treatment the chains are closer together in one direction and farther apart at nearly right angles to that direction. The units, however, have not been shifted from their position in the chain.

The extent to which this chain structure exerts an influence on the fiber markings so commonly seen in the microscope is probably not very great. This is evident especially when one recalls that a thin cell wall only one micron in thickness would require between 2000 and 3000 chains laid side by side to make up the one micron. Markings such as spiral thickenings or thickenings of any kind that are large enough to be visible would involve an enormous number of $C_6H_{10}O_5$ groups, the number reaching into the billions for a piece as small as a cubic micron. This makes it seem extremely probable that the inherent properties of the C_6 group would have little to do with the shape of structures which could be built from those units. It seems much more likely that the forms of visible markings are due to local protoplasmic activities rather than to individual peculiarities of the $C_6H_{10}O_5$ group of atoms.

A suggestion which comes out of this concept of chain structure is concerned with the way in which the chain can be built up lengthwise. The assumption is made that a glucose molecule is transformed into an anhydrous residue which at the same time becomes a part of a long string-like molecule of cellulose. It would seem that these long molecules of cellulose are not formed first and then placed in the wall but are formed in place as a part of the process of building the wall. The result is the transformation of a glucose molecule into a structural unit of a cellulose molecule and at the same time into a unit of the wall of the fiber.

S. B. Detwiler.

Biological and Practical Researches into Bluing in Pine and Spruce. By T. Lagerberg, G. Lundberg, and E. Melin. *Svenska Skogsvårdsföreningens Tidskrift 2: 561-739. 1927.*

A part of this important study by Lagerberg, Lundberg, and Melin has been reviewed in a previous issue of this Journal. The present review covers that portion of the study dealing with the influence of different factors upon the development of bluing fungi and the damage to round timber with different methods of storage and treatment. The discussion on the damage to round timber by sap stain organisms is based upon data collected by Martin Enander, Chief Assistant Forester at Garpenberg.

Among the various factors influencing the development of sap stain fungi are (a) water and oxygen content, (b) temperature and (c) the timber itself.

In their consideration of the influence of the moisture content of wood, the authors are to be congratulated on the fact

that in part of their tests wood with "primarily" free water was used. By this term is meant wood which has not been previously dried, but which still contained all or part of the original moisture in the fresh wood. In other tests wood with "secondarily" free water, i. e., seasoned wood to which water was added, was used. Naturally enough, the sap stain fungi reacted differently on wood with primarily and secondarily free water.

The moisture content is also expressed in two different ways: (1) actual percentage of water (based on the dry weight of the wood), and (2) the degree of saturation, i. e., the amount of moisture actually in the wood compared with the maximum amount the wood will absorb. Using these two methods of expressing moisture content necessarily involves the presentation of the data.

Complete sterilization of the test blocks was avoided because the wood undergoes certain changes at higher temperatures. Sterilization was effected by moist heat at 50° C., it being maintained that at this temperature the physical and chemical structure of the wood is not greatly changed. This may be quite true, but it is very likely that the contents of the living ray parenchyma cells undergo considerable change, even if the protoplasm is not actually "killed" at this temperature.

In general, the results confirm those of Münch: that the supply of oxygen is a decisive factor for the growth of sap stain fungi when the water content of the wood is high. The wood must hold a definite quantity of oxygen to enable the fungi to thrive and cause bluing. The oxygen cannot be conveyed through the mycelium from without but must be present in the wood itself. Not all of the bluing fungi have the same oxygen requirement. Among the least exacting in this respect are *Ceratostomella pini, Endoconidiophora coerculescens,* and *Hormonema dematioides.* Among the most exacting are *Discula pinicola* and *Trichosporium tingens.* The oxygen requirements seem to increase when other growth conditions are unfavorable.

In winter-felled pine timber with a natural water content, namely, 145 per cent (70 per cent of saturation), all the sap stain fungi studied developed slowly. A reduction of the water content by only 10 per cent, however, enabled the fungi to develop at their optimum rate. The zone of optimum development is rather broad, extending from approximately 60 per cent to about 20 per cent of saturation. When the moisture content falls to about 27 or 28 per cent of the maximum water holding capacity (approximate fiber saturation point), the growth of all the fungi studied ceases. In other words, free water in the wood is essential before the growth of the sap stain fungi is possible.

The minimum temperature at which the sap stain fungi will grow on malt agar was not determined, but it is supposed to lie slightly above 0° C. Optimum growth on malt agar occurred at temperatures ranging between 19° C. and 22° C., but was not determined definitely.

It seems to be generally accepted in Sweden that spruce wood (*Picea excelsa*) is less subject to bluing than pine wood (*Pinus silvestris*). The results obtained from a study of this question seem to indicate that spruce wood is a less suitable substratum for bluing fungi than is pine wood. However, there is no

foundation for the belief that spruce wood is not subject to bluing.

An effort was made to gain some insight into the reasons for this difference, but it appears that the bluing fungi are not so specialized in regard to their carbon source as has been hitherto assumed. Neither are they pronounced fat-fungi or starch-fungi. Thus it appears that it is not the foodstuffs available in pine and spruce which account for the different reactions of bluing fungi on these woods. It is to be regretted that the authors did not study the possibility of the existence of certain substances in spruce wood which inhibit the growth of these fungi. Substances toxic to the wood-destroying fungi are of course known to occur in naturally durable woods such as oak, redwood, etc.

From a nutritive point of view spring- and summer-felled wood is not more favorable for the development of blue stain fungi than winter-felled wood. The sapwood, however, was found to contain considerably less moisture during the summer than during the winter. This is particularly true during dry summers and may in part account for the more rapid development of sap stain fungi on such wood.

The density of pine wood, as indicated by the number of growth rings per inch, has in itself no great influence upon the rate of development of bluing fungi. This appears a logical conclusion since the hyphæ grow chiefly in pith rays.

Considerable work has been done in the United States on the prevention of sap stain in logs and some fairly successful methods have been devised to decrease these losses. The control methods employed by the authors are interesting, but it is doubtful if they lend themselves to our economic conditions. In general, it is suggested, when it is necessary to store logs over one summer and water storage is not practical, that the bark be left on the logs and that they be placed in closely stacked piles covered with spruce twigs, raw humus, or litter.

It is very important that these stacks be large and that they be erected in cold shady places as early in the spring as possible in order to keep wood at a low temperature. Logs cannot be stored in piles such as this for too long periods, certainly not through the second summer, or serious losses from decay will result.

If pulpwood is to be stored it is recommended that the bark be removed from the bolts, which should then be piled in open piles to permit rapid seasoning.

Lagerberg, Lundberg, and Melin have made a real contribution to our knowledge of sap stain in wood. Not only have the basic facts underlying the problem been carefully studied, but the results obtained have been translated to woods practice.

HENRY SCHMITZ.

Vorschlag zu einer forstlichen Betriebsstatistik. By Kurt Stephani, President, Society of Baden Foresters, Forbach in Baden, Germany. *Pp. 96, tables 11. M. & H. Schaper, Publishers, Hannover. 1929. Price $1.*

Have you ever seen any forests in Germany? If you have, you will remember, foremost among them, the "Schifferschaftswald" in the Black Forest: foremost for its stumpage, averaging 42,000 board feet per acre; fore-

most for its history, the present mature stand being the "second growth" of the primeval; foremost for its forester, Kurt Stephani, author of the publication here discussed. Pity that the book is written—though it is well written—in the German idiom! Every page of it is replete with interesting facts for all those in the U. S. A. who are clamoring for "capitalistic" forestry.

The book describes—its title is misleading—the investments and the returns in the Schifferschaftswald, on an area of 13,000 acres situated in the Black Forest and owned, for centuries, by a joint stock company of "Schiffers" (skippers, masters of rafts) who were sending rafts of spruce and fir from the Black Forest to the Netherlands on the Rhine.

There are 11 tabulations, almost all of them historically statistical. Table 1 shows how the original beech was replaced automatically by fir, and fir in turn by spruce, so that the present stockholders have the advantage of the most valuable species prevailing. Table 2 shows the development of the age classes since 1876, when the young ones prevailed, while today the opposite is the case. Table 3 gives the annual returns in cubic meters, separating fuelwood from timber, since 1814. Table 6 (I cannot describe them all) gives the gross returns in marks since 1884. Table 10 shows the annual outlay for roads, which have taken the place of splash dams and of fixtures for driving, since 1860. Table 11 details the annual net returns.

These are, of late, as much as $15.07 per acre per year. "Capital!" you will say; "here it is proven that forestry *is* a remunerative investment! One hundred years ago, the revenue was as many cents per acre as it is dollars per acre in 1928!"

Alas, what is the value of the standing timber, also, per acre? Stephani's book does not give any answer. You can, however, obtain an answer, yourself, by multiplying the stand by the present stumpage value; doing that, you arrive at $600 per acre. The annual dividend is, then, $\frac{15}{600} = 2.5\%$ The money invested in roads and soil and farms and buildings is *not* included in my $600.

The "Schifferschaftswald" is interesting for another reason: while it belongs to a joint stock company, 51% of the stock has been acquired, in the course of the last 50 years, by the government. It has thus become what they call in Germany—and what you find so often in parts of modern Europe—a "gemischtwirtschaftlicher Betrieb," that is, a capitalistic arrangement by which the interests of the people are safeguarded by the *capital* of the people, and by which the business interests of the stockholders are maintained by their *intelligent representation*.

Is it an accident that the Schifferschaftswald, by this unique sort of a managerial and capitalistic combination, has become the best piece of forestry in Europe?

C. A. Schenck.

Engineering for Forest Rangers in Tropical Countries. By A. H. Lloyd. *Oxford University Press, 114 Fifth Avenue, New York. 1929. Pp. 228.*

This book constitutes a very elementary discussion of the ordinary problems

of road, trail, and building construction as commonly encountered in the administration of forests in tropical countries with special reference to Burma. Although well indexed, it can hardly be considered a manual of forest engineering, as it is described by the Chief Conservator of Forests for Burma in the foreword and by the author in his preface. It is very detailed and is more in the form of an expanded series of lecture notes than of a manual. It is exceptionally well illustrated and should serve admirably the purpose for which it was prepared—a text-book for students of forest engineering at the Burma Forest School.

D. M. MATTHEWS.

A Contribution Toward a Monograph of the Adelginae (Phylloxeridae) of North America. By P. N. Annand. *Stanford University Publications, Biological Sciences, Vol. 1, No. 1, Pp. 146, figs. 31. 1928.*

This monograph on the aphids of North American conifers, although principally of interest to the specialist, is not without value to the forester. This group of aphids causes considerable damage since it contains a number of species which deform the branches of their host and deplete its vitality by sucking the sap. The group, which includes the spruce gall aphids, whose work is so well known to most foresters, will become of increasing economic importance as our efforts are more and more transferred from the exploitation of virgin stands to the regeneration of young stands, since these insects are most harmful in seedlings and saplings. For the important species the types of galls are described and the damage to the hosts discussed.

Taxonomically, these aphids have been in a state of confusion, and in this paper the author has attempted to describe critically all species now known in North America. Unfortunately, he was not able to get material from the South to make the work regionally complete.

There is a brief but interesting discussion of the problem of biological species in which the author takes a sound view. The line drawings with which the text is illustrated are well done, and the publication is a very creditable piece of work in a difficult field. To the reader other than the specialist, however, the value of the paper would have been considerably enhanced by the addition of a host index, even though, as pointed out by the author, such an index would necessarily have been incomplete and to some extent inaccurate.

J. S. BOYCE.

The Economic Aspects of Forest Destruction in Northern Michigan. By William N. Sparhawk, Senior Forest Economist, and Warren D. Brush, Forest Examiner, Branch of Research, Forest Service. *U. S. Dept. of Agric. Technical Bulletin No. 92, January, 1929.*

This bulletin has already been considerably reviewed. Newspapers, lumber trade journals, and forestry publications have published considerable excerpts from it. Commendation has been instantaneous and almost universal. If what is said here has any value it will be

in the expression of feeling aroused in a "native son" on reading the bulletin. Why is it that Michigan must always be the goat when the sins of deforestation are to be paraded?

Authors Sparhawk and Brush have assembled an imposing array of figures. They have evidently searched thoroughly the existing records and they have put it all down on paper. They have sunk their axe deep, and if the flying chips hit a few bystanders, what matter? Only one wishes the subject could have been treated with more sympathetic understanding of Michigan's internal problems, of which forest destruction is only a part.

The bulletin sets forth in cold figures facts that hurt. Michigan, starting with wealth in timber greater than that of gold mines, in less than two generations has dissipated its inheritance. Much of the timber was burned, some carelessly, some to make way for farms. The timber that was cut went to build up other regions—to Michigan was left the impoverished lands that had grown the timber. Towns built up about mills whose capacity was in excess of the timber have dwindled. Farms, dependent on income from labor in the surrounding forest, have had to be abandoned. Industries dependent on timber for raw materials have been forced to move or to go out of business. Labor, especially of that virile age necessary to successful pioneering, has followed the industries. Remain the idle, unproductive acres—abandoned farm lands, burned over, cut-over timberlands, highly taxed and yet unproductive—bankrupt. And a population of old people, isolated from social and educational contacts, clinging desperately to the worn-out soil. The figures as quoted are stupendous. They are almost unanswerable. One emerges from a perusal of the bulletin, dazed; and a bit resentful at what seems to be a gloating attitude on the part of Sparhawk and Brush. No family likes to have its skeletons thus paraded.

We here in Michigan are proud of our agricultural Land Certification Act and of our Land Economic Survey. We want to know and we want the world to know just what our land problem is. What we object to is the over-emphasis on certain unsavory phases of it which operates to discourage legitimate development. We have taken great comfort in our recreational possibilities. We have seen new values come into our cut-over timberlands. And the authors dismiss them with a scant paragraph. They are all for growing timber as timber, not game cover. It is at this point of recreation as a major forest product that I find myself differing sharply from the authors. And this divergence continues decidedly into the "Forest Program for Michigan" as they outline it.

State Forester Schaaf in 1917 presented a reforestation plan for Michigan not far different from the one presented in the bulletin. Three conditions then would have made Schaaf's plan ineffective and the same three conditions are present now. They are (1) public apathy, (2) financial stringency, and (3) fires. Sparhawk and Brush claim that public apathy is due to the prevalent theory that all possible land should be held for agriculture. I consider that a dead issue in Michigan. Apathy here is due mainly to difficulty in showing definite immediate results, to inherent reluctance to invade property rights, and to the hope that science in some way will evolve substitutes

to relieve us from the impending timber shortage. No one who has watched the efforts of governor and legislature, these past few months, to raise funds for our overburdened prisons and hospitals, will deny financial stringency or hope for any expenditure in reforestation on the scale proposed. Increase in property tax for reforestation on any large scale is impossible under present conditions. The growing of timber is essentially different from a park or road construction program in that it has no immediate apparent benefit to offer. I would not want to sanction any kind of a bond issue for Michigan without first being assured of the expansion and training of a force technically equipped to properly spend the money. It is significant that the agitation for a bond issue in this state has come from the sportsmen's groups, rather than from the industrialists. Improvement in fires is problematical. When we get state-wide protection with annual burning down to 0.2 per cent of area, then the growing of timber will be on a business basis and not until then.

Our legislature of two years ago passed the amended Timber Tax Exemption Act with a great flourish. The act was hailed as a panacea for timber production problems. It fizzled. We know now that the ten million acres of privately owned timber-producing land in northern Michigan that the bulletin counts on will never be realized. The state is going to have to carry the load, not just three and a half million but eight to ten million acres. Why then, with bankrupt lands coming in faster than we can take care of them, restrict ourselves to the policy of "poorer lands first"? The proposal of a "State Planning Commission" is good. I would like to see such an organization working alongside of Senator Conlon's state committee of inquiry into taxation. I am afraid that the effort of the latter is going to be expended largely toward the raising of funds for immediate need rather than investment in future welfare.

We are progressing in Michigan, slowly but surely. Not so fast as some, possibly not so many setbacks. It is a long hard trail. We have to be careful about the short cuts. What I object to in the bulletin is that it is too much a Jeremiah weeping over lost Israel. What we need is a Moses to lead us through the wilderness.

What I like about the bulletin, there isn't room to say here. Better said, perhaps, that I am going to try to get a copy of it into the hands of every one of our Michigan Forestry Association members.

JOHN C. DE CAMP.

The Quality of Appalachian Hickory. By Benson H. Paul. *Southern Lumberman, Nashville, Tenn., April 6, 1928. Pp. 4, pl. 9, tables 2.* Available as reprints.

In this article the author reports his investigation of the properties of Appalachian hickory. He finds that "in general, the average strength of Appalachian hickory compares favorably with hickory from other parts of the country," but that "all Appalachian hickory, however, does not have sufficient strength to meet the requirements of the customary uses of hickory." The second-growth he found to be as high in shock-resisting properties as any hickory previously tested from other parts of the country. The weak material developed from the

side-cuts from the larger old-growth trees where the growth was slow. The clear heartwood from inner portions was found to be usually of good strength. As a criterion of strength, rapid growth and high specific gravity are given, though "very often hickory of slow growth is also very strong." Utilization of Appalachian hickory requires a segregation of the strong stock from the weak and finding a use for the material of low quality and strength.

Hickory is not abundant in the Appalachians, forming, according to the author, only from 1 to 4 per cent of the stand in the three National Forests where material was collected. The important hickory species found in the Appalachians are *Hicoria glabra, H. ovata,* and *H. cordiformis,* with *H. alba* rather scarce.

Since the second-growth material from this region indicated such good strength properties, it is certain that the Appalachians can produce hickory of excellent strength in the future. This fact, the author believes, assures the future usefulness of the hickory there grown. Silvicultural aspects, according to the author, are in its favor.

"Although fairly tolerant, the intense competition of faster growing species in the virgin forest has prevented it from doing its best. In the second-growth stands many of the hickory trees will be large enough to remove before the competition becomes too severe. . . . . Leaving the hickory trees behind in present logging operations is likely to increase the amount of hickory in the next rotation.

"Because of its usefulness in small sizes, hickory can be grown on a fairly short rotation. On good soils trees which have sufficient growing space will reach merchantable size in 50 years. Such trees will contain practically all white hickory which will doubtless be an added advantage in marketing it, for even if the sapwood is not intrinsically stronger than the heartwood, the clear white appearance of the sapwood will always be an advantage. At present there is very little second-growth hickory of merchantable size in the Southern Appalachian Mountain region.

"It is felt that the hickories should be considered among the more desirable species of the Appalachian region. Most of the species have exceptional qualities that fit them for special uses for which other woods are not suited. On the better soils in the forests of the Appalachian region, hickory may be able to partly take the place of the chestnut which is so rapidly disappearing from the stands because of the ravages of the chestnut blight."

EMANUEL FRITZ.

Los Angeles County Forestry Department. Report for Fiscal Year 1927-28.

The duties of the County Forester are many and varied. He is in charge of the development and maintenance of county parks, and of the planting and maintenance of watersheds, roadsides, and administrative sites. As ex-officio County Fire, Fish, and Game Warden, he deals with all fire prevention and suppression in unincorporated territory outside of national forests and with protection of game and fish resources.

The department has two main divisions—Forestry and Fire Warden, with a number of subdivisions.

The two outstanding activities of the Forestry Division were roadside planting and forestation. Over 12,000 roadside trees were planted and about 4,500 removed for various reasons. Over 22,500

trees were trimmed, and the total number maintained was over 48,000. The two nurseries for ornamentals contained over 105,000 trees, shrubs, and plants, of which 12,800 were trees for roadside planting.

For forestation work on watersheds, 6,698 pounds of tree seeds and 510 pounds of brush seeds were collected. Six forest tree nurseries contained nearly 154,000 seedlings, over 68,000 transplants, and over 61,500 potted stock. The species included incense cedar, redwood, bigtree, spruce, deodar, live oak, white fir, Douglas fir, Port Orford cedar, and the following pines: Coulter, digger, Aleppo, Jeffrey, knobcone, piñon, Scotch, Japanese black, Torrey, western yellow, lodgepole, Canary Island, Monterey, and sugar.

The fire season was unusually long and severe with a total estimated damage of over $6,500,000, of which $5,890,000 covered damage to brush watersheds and $297,000 damage to timber. Only 328 acres of timber were burned, but the area of brush fires was 24,561 acres. The total number of fires was 311. Of these, 157 covered less than one acre, and only 10 covered more than 500 acres.

Over 63 miles of new firebreak were cut; 18.65 miles of new trail and 49.8 miles of permanent telephone lines were built.

A large amount of educational work, especially in fire prevention, was done.

Under law enforcement, 907 arrests for fire violations were made with 890 convictions. Arrests for violations of game and fish laws totalled 133 with 123 convictions.

The total appropriations were $1,377,781, of which $642,249 was for the various "fire protection districts," covering (apparently) unincorporated residential areas.

L. J. Young.

Slash in Chir Pine (*Pinus longifolia*) Forests: Causes of Formation, its Influence and Treatment. By J. E. C. Turner. *Indian Forest Records 13 (7): 1-46, 293-338. 25 pl. 1928.*

Slash (débris resulting from the exploitation of chir pine trees and from their destruction by wind, snow, fire, lightning, floods, landslips, insects, and fungi) is particularly undesirable in the chir forests of the Kumaon Circle, United Provinces, because of its high inflammability. Close utilization and dense village populations requiring fuelwood both tend to decrease the size and amount of slash. The more exacting the specifications for sawn timber, the larger will be the quantity of slash resulting from conversion.

Slash greatly increases the fire hazard and hinders or prevents establishment of chir reproduction. Regeneration on slash-covered areas is apt to be irregular, whereas uniformity in age and size is desired. On regeneration areas all débris should be removed for a distance of 12 to 15 feet around seed trees. Branchwood and smaller débris should be piled in small, low piles and burned during winter when fires will not spread. Logs for which there is no use should be rolled out so they lie at right angles to the contours of the slope, with the butts down hill. In this position the logs will not roll down against seed-bearing trees.

Care should be exercised in moving logs and locating piles of slash so as to protect seed trees and advance reproduction. Trees hung up in felling and standing snags should be felled and disposed of.

Controlled up-hill burning of areas is considered advisable if the average height of the seedlings is between two and three feet, provided there has previously been a thorough disposal of the slash. Controlled burning is unpardonable if all débris has not received adequate attention beforehand. Slash disposal should be prompt after the sawn timber is removed. It is stated that charring the logs and tops during controlled burning renders them less susceptible to ignition in case of a later incendiary fire. To the reviewer it seems questionable whether the advantage thus gained by "fire-proofing" the larger slash would not be offset by the much slower subsequent decay of this material. It seems likely that both insects and fungi would be slower to attack charred débris and that it would remain on the ground for a much longer time than if it was not charred.

The strong features of this publication are the numerous excellent full-page illustrations and the clear manner of presentation.

H. J. LUTZ.

NOTES

Twenty-Seventh Annual Meeting of National Lumber Manufacturers Association

The twenty-seventh annual meeting of the National Lumber Manufacturers Association held in Chicago, April 24-26, 1929, will go down in the history of lumbering with several of its recent predecessors as of outstanding importance and as checking off another mile post in the real progress being made by the lumber industry. This meeting was also, or should be, of distinct interest to foresters because it concerned itself so vitally with the marketing of the product the forester proposes to grow.

The outstanding piece of business considered at the meeting was, of course, the Association's large trade promotion program—still regarded by many as the wonder of the industry, because the unification of the industry upon such an undertaking was a real achievement. It is gratifying to learn that the members of the Association approved the promotion policy of its new trade extension manager, W. F. Shaw, and its own trade extension committee. An outstanding feature of this policy and program is the trade-marking and grade-marking on a national scale of the product of member mills. This very important subject is apparently not yet settled in anything like final form. The adoption of any grade- and trade-marking policy is not as simple as it seems on its face. The many problems and divergent interests involved necessarily make progress slow.

Important changes in the trade promotion organization are to be effected. There will be stronger centralization in the Washington headquarters and consequently redefinition of the functions and duties of the several branch offices. There will be assignments of specialists to specific fields, closer coöperation with regional associations, and concentration of efforts on the greater marketing territories. There will also be an attempt to marshal its powers on fronts exposed by research, or, as Mr. Shaw puts it:

"When research uncovers facts, let us say about heavy mill construction, and publishes those facts in an attractive way, and our advertising copy focuses attention upon those facts, our field men and the field men of all regional associations, and all lumber salesmen, must be alert to take advantage of the opportunity thus created to increase lumber uses in the field. Then is our golden moment. It is not time to look for the pot of gold at the end of other rainbows. Our publication schedule, our advertising copy, our field work, will be 'timed' to permit focusing the full strength of the industry at strategic moments of greatest possibility."

Greater effort is to be spent on building code work, for, as Mr. Shaw says, "Of what avail to spend hundreds of thousands of dollars in an effort to sell lumber if cities pass laws reducing the amount of lumber that may be used?" Much of the trade promotion effort will also go into a vigorous campaign to put

into effect the trade-marking and grade-marking program the association has launched.

Doubtless many subscribers to the trade extension campaign of the National Association are impatient for results, and doubtless also many have ideas of their own on how the campaign should be conducted. These are important factors in slowing up progress in such an undertaking, yet there is sufficient unanimity to assure continuation of the trade extension ship's scheduled sailings, even though the skipper has been changed. The lumber industry has lost so much ground and has been so utterly unprepared to conduct a campaign that all the subscribers should expect for several years is the organization of its army, the scouting of enemy positions, and the fortification of its own lines. Not until these are accomplished and perfected, can successful offensive operations be undertaken.

The Association also gave its approval to a more comprehensive plan of reporting statistics than has ever before obtained in the industry. Along with the usual statistics on orders, shipments, and production, are to be included data on consumption. Coöperation with the Census Bureau is very probable. The lumber industry has always drifted with the winds and currents and never has had really reliable nor adequate statistics whereby it could chart a direct course toward its objectives. Statistics should be to the lumber industry what forest data are to the forester when he makes a working plan.

The President of the Association, Mr. E. L. Carpenter, who, incidentally, was reëlected, spoke optimistically of the "improved state of the industry." He said in part:

"It is only two or three years ago since this industry of ours seemed to be in the grip of an inferiority complex. Several things have happened since that time, which have enabled us to snap out of that condition and make progress. The first thing I refer to is the splendid effort to raise a fund for trade promotion. That fund was raised by the heroic efforts of a number of faithful lumbermen. It looked hopeless for a time, but they held on until the sum was raised and we are on our way. The high point in the industry today, it seems to me, is this Trade Promotion program, under which comes trade-marking and grade-marking and other points you have heard discussed. In addition to that, the conservation program.

"My personal conviction is that the improved state of the industry today is due to these facts: (1) The starting of this real trade-extension program; (2) this conservation movement; and (3) endeavoring to learn something about the business in the way of more extensive statistical information."

The annual address and report of the Association's secretary-manager, Dr. Wilson Compton, are always of particular interest. His annual reports are nothing if they are not direct and forceful, and if they do not show a most intimate knowledge of the problems of the lumber industry. Unfortunately, in the past, the very sick giant has ignored the expert's diagnosis. This year Dr. Compton appealed for more facts to guide the industry in attempting its restoration. He said, in part:

"With the aid of dependable facts and competent leadership, I know of no reason why the lumber industry cannot maintain always a position as one of the greatest of American industries. But without facts to guide it, there can be no wise leadership. My suggestion, there-

fore, is that consideration as promptly as possible be given to a systematic plan of economic surveys and research, more fundamental and more extensive than the industry, or any part of it, has heretofore attempted. I believe it should be a concerted program, participated in by the national and the regional associations and the wood-using industries, and for some purposes by the United States Government."

He wants to know, for example: What will be the effect upon the use of lumber of the constantly increasing purchasing power and general advance in the standard of living of the American people; what will be the effect upon the lumber industry of the more exacting buying habits of the American people; what will be the effect upon the use of lumber resulting from the lack of exact knowledge of wood properties and the suitability of specific species for specific purposes; the extent to which differences in the character of preparation, in care in seasoning, and in extent of refinement affect utility value of lumber to the consumer; the extent to which seasonal variations in lumber consumption in industrial uses, and particularly in construction, affect the demand for and use of sawmill products; what are the prospects of competition in American markets from foreign sources of lumber supply; where do our lumber exports go, for what purposes are they used and what competition from other sources do they meet; just how and to what extent distribution facilities of the lumber industry are capable of improvement; what portion of the $420,000,000 annual freight bill paid by the lumber industry comes out of the manufacturer's realization; what permanent effect may be expected from the speedy transportation service which now prevails; what are the effects on orderly lumber distribution of consignment car and cargo business; what price can consumers of lumber afford to pay for lumber before they can afford to use some substitute material; what substitutes for lumber are available in each of its important uses, in market, volume and price; and what are the sources of lumber demand in terms of specific consumer's uses. Dr. Compton concluded his address with the words:

"There are many lumbermen who still believe that a way can be found, and should be found, to compel the American people to buy lumber and use lumber made and sold the way it was made and sold 25 years ago. Mr. Ford had the same idea with his old model T Ford, a few years ago when he produced over half of the automobile output, tried to stick to his old-fashioned model, to force his own preferences upon a buying public which did not care to submit to dictation and to go against the current in the automobile world. All he did was to lose—perhaps only temporarily—his dominant position in the motor world.

"The lumber industry cannot itself determine and control these economic changes and currents. It can influence them only in part. What it can determine and can control, if it will, is the extent to which and the manner in which it will conform itself to these changing conditions. Statesmanship, it is said, is finding out which way God Almighty is going and then getting things out of His way.'"

Forestry received some attention in the president's address, as noted above, and in the following resolution adopted by the Association:

"Because of rapidly increasing desire among lumbermen to perpetuate forest resources and their industry by improved utilization, suitable cutting methods and reforestation, we request the executive officials and appropriate committees of

the National Lumber Manufacturers Association to intensify the development of our forestry policy and program so as to assure all concerned its services along at least three lines, namely:

"(1) Study of the methods and successes of the large number of lumbermen already engaged in growing new forests, with publication of reliable information so obtained in order to assist the industry in the extension of forestry practice.

"(2) Encouragement and assistance to regional efforts that seek better forestry methods, sentiment and legislation.

"(3) Expert and authentic representation of the industry in forestry matters on occasions suggesting such contact with private or governmental agencies.

"We believe the importance of the forestry program of the National Lumber Manufacturers Association calls for recognition both within and without the Association by establishing it as a distinct activity of the executive organization, under such relations with the forestry and other committees as will promote mutual effectiveness."

It is inconceivable that an industry as great as the lumber industry and now going through such a strenuous period of enlightenment and reorganization should not give ear to the long continued and vigorous preachings of foresters and find out for itself "what it's all about," separate the fat from the lean, and adopt what it finds is really of value to itself. More should not be expected.

Forestry and lumbering should not be looked upon as they often are, even by some foresters, as unrelated entities. One is complementary to the other. The forester is interested in making present stands of timber go farther by a modification of logging methods, thereby assuring the public a supply of lumber and the lumberman a supply of logs. The lumberman, on the other hand, is interested in trade promotion and other association activities in the hope that they will make or hold for him continued and profitable markets for his products. By thus safeguarding the markets for wood, he automatically safeguards the profession of forestry. A tree saved or grown without an assured market for its product is saved or grown unnecessarily.

EMMANUEL FRITZ.

HIGH LIGHTS OF THE ELEVENTH SOUTHERN FORESTRY CONGRESS

No one who is interested in forestry could have attended the Eleventh Southern Forestry Congress at New Orleans, April 4-6, 1929, without feeling encouraged as to the future of timber growing in the South. The 34 papers and addresses presented in a well-balanced two-day program were noteworthy for the new facts brought out and the progress recorded, as well as the promises held out for the future. In fact, this meeting expressed so clearly the growing public interest in practical forestry in the Southern States that its proceedings will be of interest to the entire forestry profession.

The Southern Forestry Congress is unique among American organizations. It was formed in 1916 by a small group of earnest men to encourage the conservation and regrowth of timber in the 16 Southern States. Having no qualifications for membership or membership dues and supported by the voluntary contributions of interested men from the different States, this Congress meets annually at some point where its presence will tend to stimulate interest and promote forestry development in the State or

locality concerned. All who are sufficiently interested to attend and register are considered members.

It is significant of the practical strides which forestry is making in the South that nearly half of the papers at this meeting were by landowners, lumbermen, and naval stores operators directly interested in the business profits to be derived from timber growing. These men, coming from several different States, have been pioneers in giving serious consideration to the possibilities of commercial forestry and have had sufficient courage and vision to be willing to invest time and money in protecting their lands from fire and overgrazing, in selective cutting and the leaving of seed trees, and in artificial reforestation of non-restocking lands. Recognizing the uncertainties and risks involved in trying to grow a long-time crop such as timber, they have also seen the possibilities of profit in such growth. Their reports of substantial progress presented at this meeting should encourage other landowners to follow, with increasing confidence, in their footsteps.

The emphasis given by this Congress to the growing of hardwood timber in the South is of particular interest, as this important phase of southern forestry has been largely or entirely overlooked in previous meetings. It is now becoming apparent that millions of acres of fertile alluvial land included in the flood plains of southern rivers will not be needed for agricultural development for many years, if ever, and that the owners can secure a substantial revenue from such lands in many instances by encouraging the regrowth of valuable hardwoods through fire protection and selective cutting methods. The increasing interest in this subject was evidenced by the selection of Memphis, the recognized center of American hardwood production and headquarters of the Hardwood Manufacturers Institute, as the location of the 1930 Congress, and by the election of a well-known hardwood timberland owner and lumberman, Mr. George T. Houston, as the new President of the Congress.

The complete proceedings of the Eleventh Congress are to be made available in printed form. For the sake of those who may not have had an opportunity of reading them, the writer will attempt to point out some of the more interesting high lights of the New Orleans meeting.

PAST ACCOMPLISHMENTS OF THE CONGRESS

Among the past accomplishments of the Southern Forestry Congress during its 13 years of existence President E. F. Smith, representing the Industrial Lumber Company, Elizabeth Louisiana, in his opening address, listed the following:

1. State forestry departments organized in 15 out of 16 States; much preliminary educational work done toward this end in the one remaining State.

2. Constructive legislation passed in several States to encourage the growing of timber by private landowners, through public assistance in fire protection, reasonable taxation, and improved land management.

3. Interest and financial assistance of the Federal Government in promoting forestry in the South has been largely increased in the form of money for fire protection, for research work, for educational and coöperative work, and for the purchase of National Forests to be used for demonstration purposes.

4. Recognition secured from State legislatures of the importance of encouraging the regrowth of timber.

5. Coöperation and interest of local chambers of commerce secured in behalf of forestry as a benefit to the community and general public.

6. Appeals made to luncheon clubs, women's clubs, and other local groups of southern citizens including farmers, business men, bankers, professional men, sportsmen, and teachers, as well as school children.

PROGRESS IN LOUISIANA

Dr. V. K. Irion, Commissioner of Conservation of Louisiana, in welcoming the Congress, pointed to the following evidences of forestry progress in Louisiana:

1. Development of a new system of coöperative fire protection centering various localities where financial assistance is obtainable from local landowners. Nearly 4 million acres is now under this form of protection. Permanent improvements include 15 lookout towers, over 1000 miles of telephone lines, and many thousand miles of fire breaks. In this protected territory the burned area has been held to a very small percentage, being only 3 per cent in 1928. The protected area is increasing each year through additional contributions of landowners.

2. The state forest nursery has increased in capacity in 3 years to 2½ million seedlings which will be available in the fall of 1929. Trees are being distributed to almost every community in the State. Private forest nurseries maintained by lumber companies are producing more than 10 million seedlings a year which are being used to plant thousands of acres of land.

3. A state-wide educational campaign is carried on in behalf of forestry, including the publication of the "Conservation News," a periodical sent to some six thousand people throughout the State. Paper book covers carrying a message on fire protection are furnished to each school child in the State and every school in the State is addressed on the subject of forestry and conservation at least once a year.

IMPORTANT OBJECTIVES IN SOUTHERN FORESTRY

R. Y. Stuart, Chief Forester of the U. S. Forest Service, in outlining some of the South's forestry problems, suggested the following objectives:

1. Maintaining and increasing the productivity of the 200,000,000 acres of actual and potential forest land, which comprise one-third of the total area of the 16 Southern States.

2. Extension of adequate fire protection to all forest lands, through Federal, State, local, and private coöperation.

3. Development by public and private agencies of increased information on practical forest problems through research and fact-finding, and dissemination of that information in usable form to owners of forest lands.

4. Increasing the number and area of publicly owned Federal, State, county, and city forests as demonstration areas.

5. Adoption by each of the Southern States of a fundamentally sound method of taxing forest lands which will encourage landowners to raise timber as a business enterprise promising a reasonable profit on the investment.

FOREST TAXATION

The subject of forest taxation was given a prominent place on the program

and was discussed by W. D. Tyler of the Clinchfield Coal Corporation, Dante, Va.; P. N. Howell of the Dantzler Lumber Company, Howison, Miss.; Fred R. Fairchild of Yale University, Director of the U. S. Forest Taxation Inquiry; R. W. Wier of the Wier Longleaf Lumber Company, Houston, Texas; Henry E. Hardtner of the Urania Lumber Company, Urania, La.; Roy L. Hogue, State Forester of Mississippi; W. Goodrich Jones, Waco, Texas; and Herman von Schrenck, St. Louis, Mo. Among the aspects of the subject brought out by these speakers were the following:

1. Reforestation on a large scale will always be dependent upon private enterprise and forest lands should be taxed in a manner that will encourage landowners to raise timber on them with a reasonable expectation of profit.

2. Unwise taxation will lead, sooner or later, to the reversion of most of our forest land to the State, which would be unfortunate and undesirable.

3. Increases in timber taxes amounting to several hundred per cent in recent years are forcing rapid and wasteful exploitation of mature timber and are discouraging owners from leaving a growing stock of the smaller trees as the basis for a second cut.

4. Cut-over and burned-over lands will constitute a non-productive public liability until taxation methods have been adjusted to make it possible for private owners to reforest these lands with a reasonable expectation of securing a profit when the crop matures.

5. A nominal tax on the land itself and a severance tax on the crop when cut should replace the annual ad valorem tax as the only reasonable method of putting timber growing on the same basis of taxation as agricultural crops.

6. Forest taxation must be considered in its relation to the taxation of other forms of property, the taxable capacity of the community, and the proper balance between public resources, public expenditures, and public debts.

7. Forest taxation should be viewed from the standpoint of public interest more than that of public revenue since it can produce but a small part of the total public revenue at best and, if excessive, will reduce the productivity of forest lands sufficiently to result in diminished local business activity with consequent reduction in the total public revenue from other and more important sources.

9. Capital cannot be expected to invest in timber crops without knowing in advance what taxes will have to be paid; otherwise the growing of timber is a hazardous speculation rather than a business enterprise.

10. Equitable taxation of forest lands will, in the long run, produce a much larger amount of tax revenue from productive timber growth than can be secured from unproductive lands on which the annual taxes are so high that timber growing will not pay.

FOREST PROTECTION

The necessity of protecting forests from fire and the relation of grazing to fire protection were discussed by E. O. Siecke, Director, Texas Forest Service; S. W. Greene, Coastal Plain Experiment Station, McNeill, Miss.; James Fowler, Soperton, Ga.; B. F. Williamson, Gainesville, Fla.; C. F. Evans, U. S. Forest Service, New Orleans, La.; B. M. Lufburrow, State Forester of Georgia;

Page S. Bunker, State Forester of Alabama; L. D. Gilbert of the Southern Pine Lumber Co., Texarkana, Texas; and Lewis E. Staley, State Forester of South Carolina.

Mr. Siecke emphasized the responsibility of the States, assisted by the Federal Government, in educating the public to a realization of the value of young forests and the damage done by fires, and recommended the distribution of educational literature, the conducting of educational campaigns through the press, and the sending out of motorized moving picture shows to tell the forestry story to adults and children in every town and village. The "protection unit plan" that has been developed in some of the Southern States was also recommended as best adapted to southern needs. Under this plan the forest landowners in an advisable protection area contribute funds on an acreage basis, such funds being matched by the State and Federal Governments. The state forestry department then assumes full charge of the protective work.

In discussing the subject of "Burning the Range for Cattle," Mr. Greene pointed out that cattle raisers of the Gulf Coastal Plain are sincere in thinking that cattle can do better on range that is burned over each winter to destroy the dead and unpalatable grasses. Tests carried on for 6 years to determine the gains made by cattle on burned and unburned range have shown a consistent advantage in favor of the burned plots of from 32 to 62 pounds per head, the difference in the appearance of the cattle being readily visible and confirming the contention of the cattlemen that cattle do better on burns. This advantage of burned range appears to be mechanical, it being easier for the cattle to browse the new shoots and obtain a complete fill of the nutritious green shoots in a minimum time. The spread between weights occurs usually in the first part of the season when cattle graze widely on burns but only in concentrated patches where the fresh grass is most accessible on the "rough," or unburned, range.

Mr. Greene pointed out that the destruction of organic matter and the erosion of the soil from heavy winter rains were serious objections to annual burning and that probably the best plan, from the standpoint of both timber and cattle would be controlled grazing to reduce fire risk from dead grass and an effort to improve the range with carpet grass and lespedeza. One acre of these grasses produces more gains than ten acres of native grass either burned or unburned. Their spread is prohibited by annual burning but is encouraged by fire protection and controlled grazing. Burning and seeding with nutritive grasses, followed by controlled grazing, appears to give the best results in pasture improvement where land cannot be cultivated.

Mr. Fowler told of his success in establishing plantations of forest-pulled seedlings during the last three years and of the measures he has taken to protect his timberlands from fire. He also told of the stocking of his lands two years ago with Mexican quail which have multiplied rapidly under protection from fire and hunting.

Mr. Williamson displayed charts showing the serious destruction of organic matter from the soil by annual burning, based on careful soil analyses to a depth of 45 inches on one plot that has been burned annually for 42 years, as contrasted with an unburned plot. He

showed that the unburned plot contained 1126 pounds of nitrogen per acre more than the burned plot which it would cost $24 per acre to put back in the soil. It was also pointed out that unburned land absorbed and retained moisture better because it contained more organic matter and was therefore less subject to drought, and that it supported beneficial bacteria.

Mr. Evans stated that the estimated annual amount required for adequate fire protection in the 16 Southern States is $5,000,000, of which only $1,500,000, or 30 per cent, is now being spent. With this expenditure the percentage of area burned over has been greatly reduced in most of the States but further reduction must be made before the problem can be considered solved. A certain minimum of the people insist upon burning the range and refuse to be educated. Such people can only be reached through law enforcement and criminal prosecution, but it is difficult to secure convictions in most localities because of public sentiment.

The landowner himself should be expected to carry the principal responsibility for fire protection, according to Mr. Lufburrow. This plan has worked well in Georgia where owners are bearing 70 per cent of the cost of protection, the work being closely supervised by the State forestry department. An important element in effective protection is the creation of a local public sentiment and responsibility in the minds of all inhabitants for the prevention of forest fires.

Mr. Gilbert stated that his experience in raising cattle in the shortleaf pine region of Texas indicated that fire protection was the only method of preserving the range, since lespedeza, their principal nutritive grass, reproduces from seed and is destroyed by fire. He has found that an excellent stand of shortleaf pine seedlings comes in on grazed land and that the growth of these trees reduces the forage progressively as the trees develop. The value of the increased growth of timber is greater, however, than the loss of grazing.

The people of South Carolina are almost universal believers in annual burning of the woods, according to Mr. Staley, and one of his first tasks in connection with the new State forestry department will be to show them that this is a mistaken policy from the standpoint of private as well as public interest.

FARM WOODLANDS

Forestry development on farm woodlands was discussed by F. W. Besley, State Forester of Maryland; W. R. Mattoon, Extension Forester, U. S. Forest Service; R. W. Graeber, Extension Forester, Raleigh, N. C.; Geo. R. Phillips, State Forester of Oklahoma; G. D. Marckworth, Head of Forestry Dept., Louisiana State University; and Frederick Dunlap, State Forester of Missouri. Among the interesting points brought out were the following:

1. Farm woodlands constitute 45 per cent of the forested area east of the Great Plains and contain 40 per cent of the standing timber. In the South, 54 per cent of the area in farms is unimproved woodland and this percentage is steadily increasing under present conditions. According to Mr. Besley nearly half of all the wood and timber used in this country is consumed by farmers.

2. Forest products are an important and indispensable element in the income of the southern farmer. Estimates given by Mr. Besley show the annual use of

$108 worth of forest-grown material on the average farm and the sale of $425 worth from the farm, making a total average income of $533 per farm.

3. Post-war values of timber products are approximately 70 per cent higher than pre-war values, according to Mr. Mattoon. This compares favorably with agricultural crops which show an increase of only 25 per cent. He pointed out that if the farmer would determine the demands of the market and then use intensive methods in the production of quality products to meet that demand, he could make his woodland pay excellent returns.

4. Complete use of his land is only good business for the farmer, as stated by Mr. Phillips; there is usually more or less land on every farm that is good only for growing timber and should be utilized for that purpose.

5. More efficient marketing of farm forest products was cited by Mr. Marckworth as one of the necessary steps in making farm woodlands pay. Severance of the timber by the farmer himself and intensive cultural work in the form of thinnings and improvement cuttings to produce improved quality are also means of increasing the income from farm woodland.

6. The farmer should harvest his own timber just as he does most other crops, according to Mr. Dunlap, in order to obtain the greatest income value from it. In the mountainous sections of the Ozarks, the farms are more than two-thirds woodland and timber products are the main cash crop, ranking second only to hogs. In the prairie sections of Missouri, better methods are needed in the marketing of walnut and oak logs so as to give the farmer a maximum profit. Depots for the accumulation and sale of such logs, operated by farmers' coöperatives, were suggested by Mr. Dunlap.

GROWING HARDWOOD TIMBER

In the discussion of forest management as applied to hardwood timber, papers were read by John R. Thistlethwaite of the Thistlethwaite Lumber Co., Opelousas, La.; George T. Houston of Houston Brothers, Vicksburg, Miss.; G. H. Lentz, special investigator, Louisiana Division of Forestry; and D. R. Brewster of the National Lumber Manufacturers Association.

Mr. Thistlethwaite told of the promising growth of young hardwood timber on a tract of 11,200 acres on which cutting was started in 1907 and which has been set aside for timber growth under the Louisiana law. This timber, consisting mostly of oak, gum, and hickory, ranges in age from 18 to 22 years and shows an average annual diameter growth of about one-third of an inch. The height ranges from 65 to 95 feet, dominant trees being 70 to 80 feet tall with 15 to 35 feet of clear steam free from branches. The average volume growth on the tract is estimated at around 200 board feet of lumber per acre per year. Thinning experiments indicate that this can be increased to 300 feet, exclusive of by-products and thinnings, by the application of intensive methods. Measurements reported by Mr. Thistlethwaite on a tract of young white and red oak timber, which was partially cut over 16 and 22 years previously for staves, show an average accelerated diameter growth of three-fourths of an inch per year in the 16-year period and four-fifths of an inch per year in the 22-year period. This

means an increase from 7 to 19 inches in 16 years and an increase from 5½ to 17½ inches in 22 years. At time of cutting the average age of this stand was 50 years.

Mr. Lentz estimated that average oak and gum timber 100 to 140 years old could produce about 250 board feet per acre per year and that fully stocked stands under intensive management should yield between 500 and 750 board feet per acre per year. With their fertile soils, long growing season, and favorable weather conditions, the hardwood lands of this lower Mississippi Valley region should produce larger yields of wood per acre than possibly any other region of the United States. Little is now being done to promote regrowth of hardwoods on present logging operations, but this study indicated that selective cutting involving the removal of the larger trees and leaving the smaller trees for a second cutting offered decided possibilities of present and future profit. During dry seasons serious damage is apt to occur to hardwood timber from ground fires, while prolonged periods of high water kill seedlings of gum, hickory, ash, and oak when the trees are completely submerged. Many abandoned farm lands have grown up to thrifty young stands of oak, gum, cottonwood, and other hardwood species. In some instances the old cotton rows may still be seen in stands of timber 65 to 70 years old abandoned after the Civil War, in which trees 20 to 30 inches in diameter occur. Further research on hardwood problems is urged by Mr. Lentz, including mill scale studies to determine the profitable diameter limits to which hardwood trees should be cut.

Mr. Houston told of his experience in the selective cutting of hardwood timber over a period of 35 years in Mississippi. By protecting the young trees from injury and keeping fire out, considerable additional growth has been obtained from the younger and smaller trees left standing at the time of the earlier cuttings. If it were not for the risk of confiscation from excessive annual taxes, Mr. Houston believes that the methods used in his operations could be profitably applied to a majority of hardwood operations.

Mr. Brewster stated that growth of hardwood trees left standing after selective logging is often quite rapid and cited several instances of tracts on which such regrowth had been decidedly profitable to the owners. In the past a majority of the hardwood operators have practiced a crude form of selective cutting more or less unconsciously and the results in new growth appear to justify giving serious consideration to the deliberate adoption of selective cutting of these hardwood lands for successive crops at intervals of 10 to 20 years. The remeasurement of some sample plots of thrifty young hardwood timber in Arkansas after five years showed that gum and oak and ash timber were growing as rapidly as shortleaf pine.

PUBLIC RESPONSIBILITY IN GROWING TIMBER

In his address on this subject Senator Joseph E. Ransdell, of Louisiana, declared that unjust taxation is a serious hindrance to the practice of forestry on private lands and that taxation of timber should be placed on a sound and equitable basis. He paid tribute to the

National Lumber Manufacturers Association for its work in encouraging reforestation and regrowth of timber on lands owned by lumber companies, and in promoting less wasteful production of lumber as well as more intelligent use. He stated that there is a surplus of agricultural land and that by more intensive cultivation of the better lands millions of acres of the poorer lands might better be used for the production of trees.

COSTS AND PROFITS IN GROWING PINE TIMBER

The growing of pine timber for lumber and naval stores was discussed by L. R. Wilcoxon, of the Crossett Lumber Company, Crossett, Ark.; H. D. Cook, of Springhill, Fla.; and Wm. L. Hall, of Hall, Kellogg & Co., Consulting Engineers, Hot Springs, Ark.

Mr. Wilcoxon outlined the plans by which the Crossett Lumber Company expects to perpetuate its sawmill operation through regrowth of pine timber. Mill scale studies have shown that trees under 15 inches in diameter do not produce an operating profit. By leaving these trees, provision is made for reseeding the land and for a second cut in approximately 20 years which will keep the mill operating until the new seedlings have reached maturity in 40 or 50 years. The wide-grained lumber produced from fast-growing young trees is just as valuable and easily marketed as the slow-growth stock from old virgin trees and that the growing demand for narrow finish and short "cut-up" stock is making it possible to utilize the timber more closely with less waste. Much of the waste material formerly burned will sooner or later be used for pulpwood, fiber board, and similar uses. The company has developed its own system of fire protection, dividing its lands into four districts of about 100,000 acres each in charge of permanent district chiefs, assisted by part-time wardens. Each district is fully equipped with lookout towers and fire-fighting equipment.

Mr. Cook and Mr. Carl F. Speh, of the Pine Institute of America, who acted as Chairman, discussed the growing of pine timber from a naval stores standpoint. Mr. Cook said that he was setting out slash pine seedlings and hoped to develop fully stocked stands of timber containing from 150 to 200 trees per acre. In this way he expected his expense per tree reduced to a minimum. He also favored the use of light streaks which leave the tree in a healthier condition and produce a maximum amount of gum. Mr. Speh called attention to the trend toward production of gum by men who own the land and timber and who have an incentive to reforest and operate conservatively so as to maintain and increase the productivity of their lands.

Mr. Hall outlined problems and opportunities in connection with the growth and utilization of pine timber, stating that important changes had been taking place in the southern pine industry including the cutting out of a majority of the large mills operated on virgin timber and the coming in of some 5000 small mills operating in second growth which furnish more than half of the total production of southern pine today. Many of the large mills are now operating to a considerable extent in second growth, particularly in the shortleaf territory. Because of this large production from second-growth timber, the annual production of southern pine lumber is still over 12 billion feet which is only

17 per cent less than the peak production during the period from 1912 to 1916. The second-growth stands from which this production is coming are from 40 to 70 years old, many having come in on abandoned fields following the Civil War, with a considerable portion coming from old cuttings from which only the larger trees had been cut.

Mr. Hall estimated the present area of pine-bearing lands at about 85,000,000 acres, of which about 10,000,000 acres is virgin and the balance second growth varying in age from 5 to 70 years and representing all stages of density from lightly to fully stocked. With an average annual growth of only 100 board feet per acre per year, which is conservative, this second growth area would be producing 7½ billion feet of new growth yearly. As a result of the rapid development of fire protection throughout the South, young pine stands are gaining both in density and vigor. Forest growth is also gaining on denuded and abandoned farm land. In contrast to ten years ago, when practically no large tracts of pine land were being managed for regrowth, we now find nearly 10 million acres, or 12½ per cent of the total pine timber area, consolidated for permanent management under present or prospective reforestation plans.

The balance of the second-growth pine lands, according to Mr. Hall, are so owned that the timber is apt to be placed at the disposal of small mills just as soon as the larger trees reach merchantable size. By cutting much of this timber before it has reached its most profitable period of development and by taking the trees down to too small sizes, these small mill operations are unprofitable to themselves, hurtful to the industry, and contrary to public interest. Much productivity and profit would be gained by holding back the axe and saw for five or ten years after the larger trees reach merchantable size. Mr. Hall also mentioned the need for improved processes of manufacture in small mills to reduce waste and produce a higher quality of product. He suggested the need for a better plan of merchandising the product of small mills so as to standardize quality and market the product in an orderly manner. Among the favorable factors in the situation, he cited the marked increase in artificial reforestation, the rapid growth possible under fire protection, the acceptance of second-growth pine lumber in the markets, the efficient rail transportation and development of motor truck logging and hauling, the adequate labor supply, and the increasing consumption of lumber required in the rapid development of the South.

NEW VALUES IN THE UTILIZATION OF SOUTHERN WOODS

C. P. Winslow, Director of the U. S. Forest Products Laboratory at Madison, Wis., discussed the creation of new values for southern woods through research and technical development of processes of converting trees into usable products with minimum waste and maximum value. He mentioned the need for a national inventory of our forest resources and a survey of our future needs for lumber and other forest products. He stated that the future of the wood market is in the hands of the scientist and technician and that the growing of wood will be more or less dependent upon the profitable uses which they are able to develop for wood in competition with other materials. Logging and mill-

ing studies of southern pine are now under way to determine the sizes of trees and logs that it is profitable to cut and manufacture, and similar studies are planned for southern hardwoods. New values in the utilization of wood will be created through separating and grading wood more closely in accordance with its mechanical and physical properties, thus making it more valuable for the use intended. New values in the use of waste material will be developed through improved processes of pulping and chemical conversion.

RESOLUTIONS

Resolutions were adopted by the Congress providing for:

1. Early initiation of an adequate program of forest research by the U. S. Forest Service and coöperating agencies dealing with the technical forestry problems of the hardwood forests of the lower Mississippi Valley and Gulf Coast Regions.

2. Adequate legislative and financial support of forestry development in the South by Governors of States, State Legislatures, and Members of Congress.

3. Commendation of efforts being made by State, Federal, and other agencies to bring about better methods of handling farm woodlands, through education, demonstration, and other means, urging increased support for these activities.

4. Adjustment of methods of taxing forest lands so that growing of timber will be encouraged as a profitable commercial enterprise.

D. R. Brewster.

Pennsylvania Foresters' Conference

On February 5-6, 1929, a most inspiring and stimulating conference was held at Harrisburg, Pa., attended largely by the foresters in the State Department of Forests and Waters. That organization, under Charles E. Dorworth, secretary, and Joseph S. Illick, deputy secretary and state forester, showed unusual perspicacity and ability in marshalling practically every politically prominent man in Pennsylvania to assist in obtaining legislation and otherwise promoting the best interests of Pennsylvania state forestry. There is considerable complaint about the difficulty of passing forestry legislation in some states. If some of our forestry organizations could take a leaf out of Pennsylvania's book and secure the warm personal interest of the various important legislative committeemen and the presiding officers of the two state assemblies, as well as the Governor and other important men in their state, in attending a state-wide forestry meeting and pledging their support, many of our state forestry problems would be readily solved.

Secretary Dorworth, in opening the conference, outlined the purpose of the meeting and introduced Governor John S. Fisher, who pledged his warm support to the cause of forestry. Members of the Pennsylvania State Forestry Commission and State Forester Joseph S. Illick discussed Pennsylvania's forestry problems. Then followed papers by various state foresters on such matters as Construction and Maintenance of Serviceable Forest Roads, by R. H. Vought; State Forest Roads and Trails, by T. Roy Morton; Recreational Opportunities in the State

Forest, by John R. Williams; Development of State Forest Camp Site Program, by R. W. Stadden; State Forest Signs, by Charles E. Baer; Special Forestry Studies in Pennsylvania, by E. A. Zeigler; Major Forest Protection Problems, by George H. Wirt; Pennsylvania's Forest Observation Tower System, by H. E. Clipper; and Aerial Forest Surveys, by C. R. Wilber, State Forester of New Jersey.

These papers were prepared by special committees, and were the results of exhaustive experience in each particular problem. They were not theories but a record of accomplishments.

The Proceedings of this Foresters' Conference constitute a veritable textbook on Pennsylvania forestry brought up to date. They are a real contribution to the literature of state forestry, and should be in the hands of everyone interested in this subject.

Pennsylvania has advanced farther than any other state in the acquisition of state forest lands and, as pointed out by Mr. Illick, there has been an active revival of state forest land purchases in the years 1927 to 1929. This year (1929) over $1,000,000 were added to the funds available for state forest purchases.

Among other notable papers presented at this conference were A Practical Reforestation Plan, by H. E. Elliott; Demonstration Forests, by Paul H. Mulford; and Marking State Forest Boundary Lines, by T. C. Harbison.

If anyone who suspects a lack of faith in the profession, as has been indicated in recent Journal of Forestry articles, had attended this State Foresters' Conference, it would have been a great inspiration in the renewal of one's loyalty, enthusiasm, and zeal for the forestry cause. The men in attendance were deeply and vitally interested in the subject. They had interesting stories to tell about their work. They were loyal to the cause and to the organization. Quite different was this Conference from the usual forestry conference. Instead of spinning fine theories, plans, and programs which should be carried out in the future, it was largely a record of real accomplishments which stands to the credit of these loyal, conscientious, and able servants of the Keystone State.

Nelson C. Brown.

"A More Scientific Method of Experimental Thinnings"

After reading with much interest the article with this title by F. I. Righter in the Journal of Forestry for March, 1929, I was surprised to find that instead of describing a new method of thinning, it dealt with methods of evaluating the results of thinning. The blanket indictment of the present methods "of conducting and evaluating thinning experiments" and the assumptions contained in the article cannot be allowed to pass unchallenged.

The argument in the second paragraph is confusing to say the least. It attempts to show that an experiment in which a plot in one part of a stand is thinned and another plot is unthinned is not scientific because the thinning automatically changes the conditions on one plot. This kind of argument leads nowhere since if the conditions were not changed no change in growth would take place. The main object of the experiment is to so change conditions of growth that better results will be obtained. The author ad-

mits that it is "customary in scientific experimentation to subject similar things to different treatment." If the stand or plots are *regarded as a whole* how does this differ from the thinning experiment?

In regard to the use of increment per cent, contrary to the assumption here that it is universally used for comparison, it is rarely used by competent investigators except when the basis is clearly shown and at the same time cubic foot or board foot increment is also shown. There can thus be no misconception due to its use. The argument that increment per cent should not be used since the basis, the volume on the plot, has been changed on the thinned plot is not sound. Thinning presupposes that the stand is overstocked. If part of this capital tied up in the forest is removed, and utilized or turned into cash, the remainder should be given the credit of earning the increased percentage. In the case of the control plot where nothing of value has been obtained in thinning, this extra wood capital is still tied up, and while it may produce as much or even more actual wood increment than the thinned plot, a poorer percentage return has been obtained. In other words, why use ten dollars' worth of wood capital to produce the same amount that five dollars of capital will produce?

Where thinnings cannot be utilized, it cannot usually be shown by comparison of either increment per cent or volume in cubic feet that the stand has been improved or that the operation is profitable. In this case it may often be shown to be profitable by a comparison of the quality increment, such as board feet.

The fourth paragraph is incomprehensible to the writer. Thinning experiments with their controls should always be made on permanent sample plots where a record of mortality comes as a matter of course. Net and gross increment (the latter including the dead during the period) must be calculated, since thinning and rethinning should be so regulated in the optimum practice that net and gross increment are the same, viz., no dead during the period. The difference between these two is one measure of the success of the thinning.

The next paragraph suggests that the control plot be marked similarly to the thinned plot, but, of course, with no trees removed. The unmarked trees on this plot could then be used at a later date with which to compare the growth of the thinned stand. As the author says, "it conforms to a scientific requirement in that it subjects like stands to different treatments." This might be a good scheme if only one thinning were to be made, but would lead to complications if more than one thinning were made, and in young stands this is imperative as the beneficial effect of the first thinning would soon disappear. It would be impossible to re-mark the control plot in the same manner as the thinned plot because conditions have changed, viz., the diameter of all the trees on the thinned plot would probably be larger than those on the control.

A much better scheme would be to follow through on both plots the growth in height and diameter of comparable trees or groups of trees. For this purpose only trees that will eventually form the final stand on the thinned plot should be used. The repeated thinnings would not result then in the elimination of some of the trees on which these comparative measurements are to be taken.

The author seems to have neglected the well-known fact that the total volume removed in repeated thinning of a stand throughout its life is often nearly as great as the total volume of the stand at the end of its rotation. Of course these thinnings early in the life of the stand may not have much value but finally the last thinning material will be of large size and very valuable. In the calculation of increment at any time during the life of the stand, all the volume removed in former thinnings must be taken into consideration.

Much of the difficulties in determining the beneficial effects of thinning can be eliminated if the trees that will probably form the final crop in the thinned plot, and a like number uniformly spaced on the control plot, are selected and marked with bands of paint. Comparisons at any time can then be made between the trees or groups of trees on the two plots from these selected trees only. These comparisons should be much better in measuring the exact effect of thinning than such schemes as comparisons of average diameters of the whole stands, where the increase in average diameter due to the axe alone enters in to mask the true relations. Since all subsequent thinning will be confined to trees other than the selected and banded ones, the basis of comparison will not be disturbed except by accident.

In conclusion I quite agree with the author that methods of evaluating the results of thinnings should be reorganized and more uniformity of practice obtained.

George A. Mulloy.

Bond Issues for Public Forests

Civil loans issued to buy land for public forests are beginning to occupy a rather prominent place in the consideration of some foresters, especially those connected with state organizations. To date the published comment on such existing or contemplated bond issues has been mostly optimistic, even to the point of being misleading. The writer feels that state, government, or minor civil bond issues *are not* financial cure-alls for the general forestry problem, and even though the bonding theory has been and is effective when applied to a particular region's recreational development, its application to forestry is not so obvious.

It is admitted that bonds are the easy way to get funds and, as Hopkins[1] points out, they solve an administrative problem by insuring in advance a continuous program of acquisition. Also admitted is the fact that land bought by moderately long-term bonds may amount to double its original cost before the issue is matured. The latter objection should be taken into account when costs per acre are enumerated, and may easily be so great as to counteract the alleged advantages of immediate acquisition before a contemplated rise in land values.

That foresters should look upon bonds as an ideal way to increase acreage of public forest lands is natural and in keeping with the present trend. They have seen bonded indebtedness of states double in the past decade. Prosperity, real or imaginary, has encouraged optimism, has forced state spending to keep up with private spending, and finally has encouraged an outlook on state credit

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[1] Journal of Forestry, Vol. XXVII, No. 2, p. 132.

only in its legal aspects. Say the foresters, "Highways, waterways, soldiers' bonuses, public buildings, and what not, all have a tap on the pork barrel. Why not forests?"

And why not? The popular revolt in the body politic which was demonstrated in a number of states last fall when bond issues for every purpose were decisively beaten is one reason why they should not. Taxpayers and voters refused to make large funds available for the use of political bodies, regardless of the purpose of the funds. After an orgy of spending and a consequent waste through graft, the term "bond issue" in a few states, at least, has come to have an insidious popular meaning.

If the political structure of a state is incapable of the efficient use of funds, it would seem that foresters should be the last persons to lend support to a measure which would create money for misuse, even though that money was ostensibly for forest land acquisition. In short, a man is known by the company he keeps; if he runs with the pack he will be hunted with it, and if foresters attempt to attain their ends through unpopular methods they must expect an unpopular reaction not only to themselves, but to the things for which they stand.

In principle, I am not entirely sold on public bond issues when applied to the purchase of state forest land, for it is believed that a state forest should be primarily a demonstration area and not necessarily a storehouse of timber resources. Once a forester avers that a state must grow the timber required for current future needs, he implies that private forest management is impracticable. I doubt if foresters, as a body, are prone to admit that.

If it is the prime function of state forests to demonstrate phases of forestry rather than create timber reservoirs, certainly it is logical to assume that a 10,000-acre tract, for instance, which can be bought from regularly allotted funds, can be made as effective an object lesson as one ten times as large; and that instead of buying vast areas of wild land for public forests, intensive application on smaller areas will serve the cause of forestry even better.

Coming back to the bond issue principle, does it not seem that a comparison of state forests with public improvements such as highways and building is rather a far-fetched analogy? The latter are specific entities, have definite proportions and costs, and finally are non-functional until complete. As a consequence, their completion is an immediate necessity and hence they call for an immediate outlay of money. Obviously bonds are necessary if costs cannot be paid out of current revenues. A forest, or a group of tracts comprising the state forest area, is the exact reverse. Forests are not specific in size, shape, or cost, and their usefulness as demonstration areas is not dependent upon any definite proportion.

In the writer's opinion, rather, forests are better built up through gradual acquisition and improvement than by the immediate purchase of extensive tracts of land upon which the improvement and management program is lagging woefully behind. While there are millions of acres of forests, public and private, being swept by fire each year, and as long as there is a crying need for a showing of real forest management on additional millions of acres, it would seem that foresters' first efforts should be directed toward protec-

tion and management and not to costly large-scale acquisition.

Leaving out Public Domain and National Forests, a state is confronted in varying degrees with one of two basic conditions regarding its forest or potential forest lands: (1) a serious idle land problem, and its resulting evils, and (2) a great bulk of land in private ownership which should receive public protection.

In the first case, the idle land in time will revert to the state or county without need of purchase; in fact it may come faster than it can be taken care of. Under such conditions, it is believed that the greatest service a state forestry organization can do is to spend its energies in making that land productive, and in most cases that task alone is sufficient to call forth the state's united efforts.

Where the idle land problem is not so serious, and where wild lands are being held in private ownership, the forester's job should be one of coöperation and education, assisting the owners in protection and by demonstration areas of state forests, showing how it is possible for private capital to manage its own resources. Here again I look upon public land buying at present as decidedly secondary, and not to be accomplished through bond issues. If, and when, a subsequent course of events proves that forestry is unattractive to private individuals, perhaps the state may then be justified in considering bonding plans.

In some regions there is still a third problem, which is not so much forestry as it is recreational and æsthetic. It exists where there are lands requiring preservation for public recreation. If these lands lie close enough to metropolitan areas and are easily accessible, or if they have inherent natural beauties that can best be preserved under public management, no one questions the advisability of state purchase. The need for recreation centers is often a vital one, and may be so urgent as to call for a bond issue, especially if it is a case of beating the real estate operators to some particularly choice sites. But only so far as forestry is concerned with recreation should it be concerned with such bond issues.

As a summary, the writer feels that a state's bonding power is something to be used with caution, and then only in emergency. Running off on a wild tangent of land buying is incidental to forestry's real tasks, and it would seem that our ends would best be served by a pay-as-we-go policy, keeping our feet on the ground, and never losing sight of the essentials.

Are we not hitching the cart before the horse and thereby throwing ourselves open to well-deserved public criticism if we saddle a debt for forest land on the future generation, when we already have millions upon millions of acres unprotected, unmanaged, and unimproved?

STANLEY S. LOCKE.

SOME ASPECTS OF INDUSTRIAL FORESTRY

The economic disadvantages of industrial forestry have been emphasized to such an extent as often to overshadow their real importance. Lack of adequate protection, unfair taxation, and meagerness of exact knowledge are real handicaps to forestry; yet other industries, and particularly those in their infancy, must face obstacles. I wonder if the development of the automotive industry was brought about by men who, a quarter of

a century ago, said, "It can't be done because of the lack of good roads, the low mechanical efficiency of the gas engine, or the dangers inherent in rapid travel." Perhaps the economic disadvantages of forestry are no more than a gadfly which will stimulate the timberland owner of real business acumen and ability to receive his just rewards and which, as in other businesses, will eliminate the inefficient and the unfit.

In contrast to these disadvantages, it may be well to list some of the decided advantages of forestry:

1. It deals with a product which is non-perishable and which is used in a large variety of ways, thus allowing time and opportunity to take advantage of the variations in market conditions.

2. It enjoys an adequate demand extending over a long period of use.

3. The investment in forestry, being for a long period, saves the cost of reinvesting.

4. It is a land investment and therefore comparatively safe.

5. The estimates of returns from timber growth can be made with as much accuracy, at least, as those upon which legitimate mining and oil concerns make their investments.

6. The possibilities of future development are good. Many fortunes have been made by "getting in on the ground floor and developing with the industry." Forestry presents this opportunity in the development of less wasteful methods of utilization and in growing a crop of trees which will be harvested when the pinch of the approaching timber famine is being keenly felt.

7. There are excellent possibilities of governmental aid, especially in the lines of research and of advice.

In the final analysis, industrial forestry will never be an assured success; as in the grocery or other business, failures are to be expected. The successful individual must understand his business, investigate thoroughly all his opportunities, and pursue a policy of efficient administration. The timberland owner who devastates his land is certainly not doing this.

The rewards of industrial forestry will not go to those owners who believe it to be visionary or its obstacles insurmountable. American progress has been brought about by the optimistic viewpoint which encourages action and which has resulted in each obstacle to success being gradually removed. No business is ever an assured success, nor are successful results obtained without coöperation and a will to do. Perhaps the time is ripe to consider devastated forest land as a monument to the unsuccessful owner.

Earl G. Mason.

Accuracy of Forest Service Standard Hypsometer

The so-called Forest Service Standard Hypsometer has been much maligned of late by various foresters, especially those engaged in research. During the course of several discussions regarding the best type of hypsometer for sample plot work, however, it became evident that little was known, by actual test, about the relative accuracy of various types of hypsometers.

In connection with some work at the Southern Forest Experiment Station the writer recently had occasion to use the "Standard" hypsometer in the measurement of 148 loblolly, shortleaf, and longleaf pines ranging from 32 to 114 feet in

height. These trees were cut subsequent to measurement and the actual heights were determined by tape so that it was possible to test the accuracy of the instrument. Total heights with both hypsometer and tape were taken to the nearest foot. The base line measured on the ground varied between 50, 66, and 100 feet, depending on the tree height. The hypsometer was used by four different men, two of whom were unfamiliar with the instrument and only one of whom had used it extensively. The condition of the five stands in which the heights were taken varied considerably. About one-third of the total number of trees occurred in an extremely scattering long-leaf-pine forest where there was very little brush or secondary growth to obstruct the view. The remainder of the measurements were taken in dense stands of loblolly and shortleaf second-growth where very often it was difficult to see the terminal shoot clearly, and occasionally the undergrowth was so dense that it was necessary to reflect the sunlight from a metal tally book cover at the base of the tree so that the instrument man could sight at the ground line.

The following tabulation shows for the 148 height measurements the actual number and the percentage of errors occurring in each foot class of errors.

Amount of error, Foot class	Number of trees	Per cent of total no. of trees
0	82	55.5
1	42	28.4
2	15	10.1
3	3	2.0
4	3	2.0
5	2	1.3
6	0	0.0
7	1	0.7
	148	100.0

In cases where base lines other than 100 feet were used, all reductions of the hypsometer reading were made mentally, which may partially explain the largest errors. The standard error of the hypsometer for all heights was found to be 1.325 feet. The average heights of all the trees measured were 60.3 and 60.2 feet for the hypsometer and tape respectively.

Standard errors were computed for the heights taken in the 5 different stands and were found to be 2.100, 1.392, 1.072, 0.976, and 0.847 feet. The stand in which the highest standard error resulted was the extremely brushy one previously mentioned.

From the outcome of this test it seems that the Forest Service Standard Hypsometer will give sufficiently accurate results for many uses where slight errors are allowable.

Leonard I. Barrett.

Arousing Interest in Rural Fire Protection

A truck with "Rural Fire Protection" emblazoned on its canvas cover follows the Farm Advisor's car into a busy little California town and rolls to an appointed spot near the school. Two men alight and busy themselves with rolling out hose lines, attaching nozzles of several types, and setting in place an array of hand tools, back-pack pumps and fire extinguishers. An anemometer turns briskly on top of a tripod set up on the cab of the truck and a small, portable gasoline pumper is set up near a hydrant with its suction hose in a tub.

Closer examination of the truck shows that it is car No. 10 of the Agricultural

Extension Service and that it has two small rotary pumps attached so that the truck engine will drive them. One is under the frame and driven by a power take-off. The other protrudes in front of the radiator and can quickly be thrown into direct connection with the crank shaft by means of a jaw clutch.

Quite a crowd gathers to watch the proceedings as a number of cars bring farmers in from the surrounding country. Presently the school bell sounds the fire alarm and children and teachers march out, taking their places near the truck. The Farm Advisor calls the meeting to order, announcing that this is one of several demonstrations in the county which he has arranged in coöperation with the State Forest Ranger and the chief of the local fire department, also that the Extension Service is holding these meetings in 28 counties this spring before the fire season, in the interests of better fire protection.

He introduces the Extension Forester who outlines briefly the importance of forest, brush, and grass cover in maintaining water absorptive capacity and soil fertility of importance watersheds, and in checking floods. He points out that California has the worst fire record of any state in the Union and cites the 4171 fires of 1928 which burned over 1,560,000 acres and resulted in damage to the extent of 2¾ million dollars; also that lightning was responsible for less than 15 per cent of these fires, while those set by smokers, incendiaries, and brush burners caused 90 per cent of the loss and were all preventable.

He points to the whirling anemometer and emphasizes the vital importance of the three factors of weather—wind, temperature, and relative humidity—in creating bad fire hazard conditions, and urges extreme care when the Weather Bureau sends out fire weather warnings. He shows a sample of oil which the Highway Commission is using to kill grass in making a fire break along critical sections of road and urges a general clean up of fire hazards in the community before the dry season.

The Extension Engineer then discusses the most important causes of farm building fires—careless storage and use of petroleum products, defective chimneys and flues, matches and smoking, overheated stoves, and spontaneous combustion. He illustrates the difference in inflammability of different clothes cleaning compounds and causes some consternation in the juvenile ranks when he "blows up" a small cocoa can to illustrate the dangers of empty gasoline barrels.

The discussion then turns to fire fighting and the importance of having "first aid" equipment at hand and ready to use. Several of the common types of fire extinguishers are shown and the methods of charging and using them are demonstrated with miniature glass models. Hand tools for fire fighting from the lowly burlap sack to the elephant hoe and pressure back-firing torch are shown and the effective use of each is pointed out.

Water, as the most common fire-quenching medium, is next taken up and various hand-pump tanks and back-pack pumps are demonstrated. Then the truck engine is started and water streams are thrown from a variety of nozzles. These vary from the spray gun using 6 gallons a minute, suitable for grass fires, to the 5/16 inch nozzle throwing 30 gallons a minute for building fires. The importance of dependable equipment of

adequate power and a well-trained volunteer crew to handle it is emphasized, and the new regulations of the Board of Fire Underwriters on these points are referred to.

Several small fires are then started and the school children have a chance to use the extinguishers and pumps in putting them out.

The meeting closes with the staccato roar of the little portable forest fire pumper and a final admonition to the group to HELP PREVENT FIRES.

Meetings of this kind were held by the two specialists in eight California counties during March, with a total attendance of 2258. In April they will work through the south coast counties to San Diego coming north through the San Joaquin and Sacramento valleys. The fire prevention campaign will close May 30 in Sutter County and it is anticipated that 10,000 people will have attended the meetings by that date.

WOODBRIDGE METCALF.

HEART'S CONTENT

A PROMISING PRECEDENT

An important action was taken recently by the National Forest Reservation Commission in purchasing a stand believed to be the last remnant of a climax forest type naturally belonging to millions of acres of land of the New York-Pennsylvania plateau.

It is well known that about half of Pennsylvania and the southern part of New York were once covered by that extremely desirable and productive natural type, the mixed white pine forest, and that this type has been practically exterminated over the whole region; most of the potential white pine land being now in second growth hardwood. There remains a little grove of white pines, two or three hundred years old, in the Cook Forest at Cooksburg, Pa. Of real climax types there seems to be nothing left but the stand at Heart's Content, about 16 miles south of Warren, Pa.

Until the consummation of the present purchase, this tract was owned by the Wheeler & Dusenbury Co. of Endeavor, Pa., one of the few survivors of the old lumber business in the state. When it became necessary for this company, as it has for others, to contemplate moving to the Pacific coast, the owners disliked to cut the last of the beautiful virgin timber at Heart's Content, so they reserved 20 acres and donated it, as a memorial, to the Allegheny National Forest. It was realized, however, that 20 acres, although involving a considerable sum of money from a business point of view, was a very small reservation, and negotiations between the Forest Service and the owners resulted in a larger area being staked out, including the 20 acre memorial area, and an additional 100 acres surrounding it. This addition was offered to the Government for purchase. The plan was enthusiastically supported from several sides, and was recently accepted by the Reservation Commission, in spite of the high price per acre of such a heavy stand, rich in white pine. The value based on the Forest Service's estimate averages not less than $650 an acre for the 100 acres, although the area includes a corner of second growth of much lower value. On parts of the land the timber values amount to $1000 per acre.

The stand is composed of a mixture of white pine and hemlock with an understory of hardwoods. The white pine trees

are 100 feet high and more (up to about 150 feet), and compose, by volume, about one-third of the stand. Somewhat more than a third of the volume is hemlock, and somewhat less than a third is composed of hardwoods. The age of the softwoods ranges from between 300 to 600 years, the hardwoods averaging much younger. The stand varies from practically pure hemlock to almost pure white pine, associated with hardwoods. The hardwood components include a fairly large number of species and indicate a tension between the Appalachian white pine type, with chestnut, oaks, and cucumber, and the Northeastern hardwoods white pine type, with beech, birch, and maple. Predominating is beech, associated with maple. Chestnut, oaks, cucumber, yellow and black birch, black cherry, and even tulip poplar, enter as minor components.

The area varies in many respects other than composition of the stand, such as topography, ground water conditions, and soil. The humus cover, always a good indicator, reflecting the variations in the primary conditions and the character of the stand, varies from a mull on unpodsolized soil to a heavy, acid, hemlock raw humus up to about 7 inches in depth, having produced a heavy podsolization, with a bleached horizon 6 inches and more in depth. It seems, however, that one of those extremes, the true mull, is not to be found within the virgin area.

These varying conditions, of course, furnish excellent material for study; the virgin conditions warranting the interpretation of the findings as representing true natural equilibria. On the other hand, the variability within the small area left as virgin is such that clear-cut results might not be obtained so easily as would have been the case if, with a given size, the area had been more uniform, or varied as it is, if it had been larger. The main value of the area, however, is that it represents a unique sample of the historic natural mixed white pine forests of the region in their full development. From this point of view, of course, the diversity within the area can hardly be too great or even great enough. It is safe to assume that no single area of a reasonable size could have been found, even if prospected for early enough, which would have been representative even of the principal types, subtypes, varieties, or whatever they may be called, which must have existed within the mixed white pine forest of the New York-Pennsylvania plateau. It is now decidedly too late for prospecting, and we must be glad to have just this one sample, lying on the tension line between the Northeastern hardwoods and Appalachian types, and try to let careful study and critical interpretation make up for the fatal lack of further material.

Unfortunately, even the 120 acres are far from being entirely in a virgin condition. About one-tenth is second growth; one-fifth is grazed and trampled by cattle, so that soil conditions are modified; and part of the balance is influenced by picnicking, so that at the most only 80 acres can be said to be in a virgin or practically virgin condition.

Of course this area is too small to permit the use of any part for silvicultural experiments, as might have been practicable if a larger sample area had been available. There is no need, however, for using any part of the remaining virgin area in this manner, because there is adjacent land, cut-over and with second growth, which would be adapted to such

purposes and also would permit interesting studies on the changes taking place in the humus and other conditions after cutting. The last of the virgin timber, outside of the staked-out area, was cut in 1928. Some records of the soil conditions prevailing before cutting were obtained at the last moment, and it is hoped that they can still be supplemented by observations next summer.

It was expressly stated by the National Forest Reservation Commission, when the purchase was decided upon, that the Heart's Content tract was to constitute a "laboratory" for research to promote forestry. With this purchase, therefore, the program first outlined by Mr. W. W. Ashe in this JOURNAL seven years ago[1] and again stressed elsewhere[2] has the stamp of official approval. The considerable economic outlay involved in the Heart's Content purchase, without any hope of direct financial return (since the area is to be maintained virgin), made the interested research men seriously fear that the Reservation Commission might hesitate to support the project. The fact that the purchase was consummated seems to show that the indispensability of natural areas for forestry and research promoting forestry has been fully realized, and forms a very valuable and promising precedent. As to price, the high figure per acre paid for the Heart's Content tract in no way form a precedent, as no other forest type in the East is believed, with present prices, ever to be able to reach more than one-fifth or one-fourth of the value per acre represented by this mixed white pine type in its optimum development. It is to be hoped, therefore, that the Government can be relied upon in the future to acquire other much needed sample areas of natural forest types, in case they cannot be found within the National Forests.

All this, satisfying as it is, is but a start toward the carrying out of Mr. Ashe's program. A satisfactory solution of this major question can, in the writer's opinion, only be attained as a result of a systematized effort under central leadership. It would seem logical, in view of the new officially recognized importance of natural areas for forestry, to expect the Forest Service to assume the task of carrying out this program. Failing this the forwarding of such a project might appropriately be considered as falling within the province of either the Society of American Foresters, or the Ecological Society of America.

In any event systematic and coordinated action should speedily be taken while the opportunity still remains to insure the preservation in their original condition of representative samples of existing forest types throughout the country.

L. G. ROMELL.

[1] W. W. Ashe. Reserved areas of principal forest types as a guide in developing American silviculture. Jour. of Forestry, Vol. 20, pp. 276-283, 1922.

[2] W. W. Ashe. The value to silviculture of reserved areas of natural forest types. Naturalist's Guide to the Americas, pp. 10-11, Baltimore, 1926.

THE THORNE PULPWOOD BARKER

Between 10 and 20 per cent of the cost of pulpwood at the average paper mill is represented by the cost of removing the bark from the wood. In nearly all methods of making paper it is neces-

sary to use only the wood, and, therefore, the bark must be removed.

The Hammermill Paper Company at Erie, Pennsylvania, uses a method for removing the bark from wood a little different from that commonly employed. The machine is known as the "Thorne Barker," and was invented by Mr. C. B. Thorne. It was installed at the Erie plant in June, 1920, and it is the only one of its kind in use in the United States, although there are two or three installations in Canada.

The usual methods of removing the bark from pulpwood are as follows:

1. Sap Peeling. During the growing season, from about May 15 to August 15, the bark can be removed from freshly cut trees very quickly by means of axes or spuds. More and more wood is being sap peeled, but the method is applicable only to wood cut during this short season.

2. Various hand methods, such as with a draw knife. Such methods are obviously very costly and are used only where other methods fail.

3. Knife Barkers. The sticks of wood are made to revolve against a knife. This method is extremely wasteful since from 25 to 40 per cent of the wood is removed with the bark.

4. Drum Barkers. The wood, usually cut into 2-foot lengths, is tumbled about in large drums until the bark comes off by contact with the drums and other pieces of wood. This is the method more commonly used in removing bark.

5. Thorne Barker. This barker is built in three long troughs just wide enough to take 4-foot wood. At least one of the installations in Canada is built to take 16-foot wood. Each of the three troughs is divided into three pockets at the bottom of which a pair of cams attached to a revolving shaft keeps the wood in motion. The cams are set at angles varying by 15 degrees so that the push on the wood in the various pockets does not come at the same moment. As a result of the arrangement the wood is given three separate motions—1st, an upward motion; 2nd, a rocking motion; 3rd, a forward motion. The sticks of wood in the troughs remain parallel and at right angles to the long axis of the troughs. The bark is removed by the rubbing of the sticks together, and, of course, with the aid of streams of water which are played on the wood.

This method of barking saves practically all of the wood and removes only the bark. It avoids the brooming of the ends of the sticks which is very objectionable in the manufacture of high-grade paper. It also avoids the additional cuts necessary where shorter length wood is required. The capacity of the Thorne Barker varies from 8 to 20 cords per hour, depending on the size and condition of the wood. Obviously small wood with tight bark reduces the capacity of the barker as compared with large size wood where the bark has been loosened by river driving.

The Hammermill Paper Company has found a considerable saving in the use of the Thorne Barker as compared with the methods formerly used. Anyone interested in further details of the barker may obtain them from the Allis-Chalmers Company at Montreal, Canada.

J. F. Preston.

A New Wood Preservative

Zinc meta-arsenite is proposed as a new wood preservative by the chemists and engineers of the Western Union

Telegraph Company. This company, in an effort to reduce its enormous annual expenditures for pole replacements and apparently alarmed by the possibility of difficulty in obtaining adequate supplies of coal-tar creosote in the future, set about to find a new preservative that would be easily obtainable in large amounts at reasonable cost, and that would be as effective in protecting wood as creosote and yet not have the disadvantage of the latter as to paintability. The investigations of its chemist, Dr. L. P. Curtin, and its construction engineer, Paul J. Howe, led to the conclusion that zinc meta-arsenite came nearest the ideal they sought.

In a prospectus distributed by the company organized to exploit the new material, Dr. Curtin and Mr. Howe present three technical papers that are discussions of their experiments. These papers were presented originally before the annual meeting of the American Wood Preservers Association in January, 1928.

In the first paper Dr. Curtin states the wood-preserving axiom "that a substance must be soluble in order to be toxic," and emphasizes that this solubility must be difficult under ordinary circumstances, yet easy enough in the weak acids liberated by the fungi to cause the latter's death and at the same time not impair materially the permanence of the preservative. "If it could be proven that acids are a by-product of fungous growth, then certain difficultly soluble salts might be brought into solution by these acids." That fungi do produce such acids was established previously, but Dr. Curtin proceeded to satisfy himself on this point in the laboratory. The investigations lead him to state that "the experiments proved conclusively that fungi growing in this medium (agar-malt syrup) liberate acid," and further that "the production of acids by fungi takes place in wood as well as in artificial nutrient." He describes his experiments in some detail.

In the second paper the same author describes his trials of a number of toxic substances and goes into some detail concerning zinc meta-arsenite, which he found attained his objective—the development of a preservative that would be "as toxic, inexpensive, and permanent as the arsenites of copper and also have the advantage of being non-corrosive to iron." The action of this material is described as follows: "When a solution containing zinc acetate and meta-arsenous acid is exposed to the air, water and acetic acid evaporate and a precipitate of zinc meta-arsenite is thrown down." "Zinc meta-arsenite," he reports, "is of very low solubility in water. . . . On the other hand, it is readily soluble in the weakest acid evolved by any of the fungi experimented with." And, "the zinc-arsenite solution has so little effect on iron that it may be regarded as non-corrosive toward that metal." His microscopic studies on wood treated with zinc meta-arsenite indicate a very effective distribution of preservative.

In the third paper, Mr. Howe presents the results of weathering and field tests on wood treated with zinc meta-arsenite and several other toxic substances. The accelerated leaching and weathering tests satisfied the author that zinc meta-arsenite is highly toxic and very permanent.

The work of Dr. Curtin and his associates deserves commendation. Results

of their actual service tests will be eagerly awaited by all interested in better wood preservation.

EMANUEL FRITZ.

COMPOSITION OF MESQUITF WOOD ASHES

Wood ash of mesquite (*Prosopis velutina*) was analyzed in November, 1928, through the courtesy of Mr. Horace G. Byers, chief, Division of Soil Chemistry and Physics, Bureau of Chemistry and Soils, U.S.D.A.; Mr. G. J. Hough, analyst. The wood was air-dried firewood cut in Florida Canyon, Santa Rita Range Reserve, Arizona. The analysis is as follows:

	Per cent
SiO_2	4.68
Fe_2O_3, Al_2O_3	2.90
CaO	49.14
MgO	1.17
K_2O	5.56
Na_2O	0.03
P_2O_5	0.73
SO_3	0.24
Carbon and undetermined (by difference)	3.27
CO_2 from carbonates	32.28

Mesquite wood burned in a stove usually retained the original form of the stick and was so firm that large pieces of the ash-mold could be handled without falling to pieces. This condition apparently is explained by Mr. Byers' comment: "The sample is very remarkable on account of the unusually large amount of calcium carbonate in the ashes." Comparison of this analysis with analyses of mesquite ashes from other regions would be of interest.

S. B. DETWILER.

THE CHESTNUT DISEASE IN FRANCE

Twenty years ago, the traveler in the hilly districts of central France would drive on roads winding for scores of miles through pure stands of chestnut trees, barely getting a glance of the sheltered thatched-roof cottages, and of the tiny, overshadowed rye or buckwheat fields. Today, as a result of the ink disease, he may drive in the same country through open land, or he may see for miles dead or dying trees that are to be felled; even where large chestnut stands still thrive he may observe here or there, among the green healthy trees, a few sickly individuals.

Pure stands of chestnut trees were conspicuous features of all western European regions where the soil was built of granites and shales, and therefore poor in calcium, and where the climate was mild enough. Practically all of these trees were grafted. Grafts were originally obtained from trees which were observed to yield high quality nuts, as the result of a variation, and perhaps even of a bud variation. These variations have been propagated by grafting for centuries; many of these have been given local names, and are often spoken of as varieties.

In many villages one or few grafted trees are specially pruned, in order to provide young vigorous shoots of the grafted varieties. Although any landowner is able to graft his own trees, a specially skilled man would often graft hundreds of his or his neighbor's trees every year. To start a new grove, seedlings were planted in rows on plowed lands, and then grafted. Plowing and raising crops between the rows went on for 10 or 15 years, until the trees had

so developed as to overshadow the whole surface.

Such stands of chestnuts were practically everlasting; the trees could be felled when 50 or 60 years old, and the stumps would throw out new shoots, one of which could be grafted into a new chestnut tree. We have visited stands where the process had been repeated for centuries, and could have been repeated for more centuries had not the ink disease interfered.

The cause of the disease was discovered by Professor Petee, in Italy, to be a mold-like fungus, closely allied to the *Phytophthora,* which he named *Blepharospora cambivora.* We observed the same fungus as the cause of the chestnut disease in Corsica and central France. It is able to live, mold-like, in the layer of decaying leaves and in the soil, even for a number of years, so that the soil remains infected long after the chestnut trees have been killed. It is also able to thrive in water, and when submerged will form special swollen organs, from which free-swimming swarm-spores emerge and carry the disease along.

Under natural conditions, the fungus will penetrate one of the roots, pushing between the bark and the wood into the most active tissues. In the case of seedlings, the roots may rot in a few days, causing the plant to wilt. In the case of a large tree, the progress of the fungus is rapid at the beginning of the season when buds start into growth, but is likely to be checked within a few weeks, when the infected tissues at the base of the tree will canker over. This however means no recovery, as the disease will progress each successive spring until the tree dies.

We have been able to correlate the way the disease progresses with some biochemical changes in affected tissues: where the rot develops rapidly, the threads of the parasitic fungus are seen to push in the living tissue of the inner cortex before any change is noticeable therein. On the contrary, where the lesion tends to heal over, large quantities of tannic material are observed to have developed in the vicinity of the rotten tissues, and this checks any further infection.

From our experiments we found that the Japanese chestnut differs from the European chestnut in that it is much quicker in developing tannic material where the fungus tends to penetrate. As a result, we always observed Japanese chestnut seedlings to heal over where they were inoculated with the parasitic *Blepharospora cambivora,* while the European seedlings would rot and die.

Under natural conditions, even the oldest and hugest trees may be killed in a few years by the disease; they cannot be replaced by other European chestnut trees, which would die within two or three years if planted in infected soils. Japanese chestnuts, however, have been thriving for 20 years where indigenous chestnuts died in a few years, and should be planted in infected areas where chestnut stands are to be maintained.

J. Dufrenoy.

An Occupational Study of Graduates in Forestry from the University of California

I was so much interested by Professor Guise's note in the Journal of Forestry for December, 1928, that I felt it worth while to borrow his title and contribute something additional to

the subject of occupations of forestry graduates. It happens that I made a classification of University of California foresters at the end of 1928, and I have just revised this to make it harmonize with Guise's classification. It would be worth while for other forestry schools to make similar analyses.

The present occupations of the 116 living "U. of C." foresters are shown in the accompanying tabulation. This number includes several who took most or all of the courses given by the forestry school, but who received their degrees in other University departments. It also includes a few who were students during the genesis of the school when it gave only a few courses, and a few who were unable quite to complete their courses and obtain a degree. Of the 116, 21 per cent have quit forestry for such unrelated fields as real estate, bonds, engineer-

OCCUPATIONS OF LIVING UNIVERSITY OF CALIFORNIA FORESTERS

MARCH 1, 1929

ALL GRADUATES

Line of work	Degree of M. S. at U. of C.		Degree of B. S.[a]		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Forestry (including lumbering and grazing)........	19	82.6	73	78.5	92	79
Other fields	4	17.4	20	21.5	24	21
Total	23	100	93	100	116	100

[a] Nine of these obtained the master's degree at other universities, and these are still in forestry or lumbering.

GRADUATES REMAINING IN FORESTRY WORK

(Including Grazing and Lumbering)

Line of work	Degree of M. S. at U. of C.		Degree of B. S.		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Federal						
Forest Service	6	31.6	27	37.0	33	35.9
Other Bureaus	3	15.8	6	8.2	9	9.8
State and County........	2	10.5	1	1.4	3	3.3
Private						
Forestry	0	0	6	8.2	6	6.5
Lumbering	2	10.5	23	31.5	25	27.2
Teaching at Forest Schools	3	15.8	1	1.4	4	4.3
Post Graduate	1	5.3	4	5.5	5	5.4
Foreign	2	10.5	5	6.8	7	7.6
Total	19	100	73	100	92	100

ing, and high school teaching. (Five or six of these, however, are out of forestry only temporarily and are merely awaiting an opportunity to get into it again.) This leaves 79 per cent still in forestry and such closely allied fields as lumbering, grazing, forest entomology, and forest pathology. Of these, over half are in what we might call purely forestry work; 25 are in some branch of the lumber business with no direct connection with forestry as such; and 5 are in grazing work.

That fewer California than Cornell graduates have left forestry is doubtless due to the fact that the western boys, living so close to the national forests and to large lumber operations, know more definitely when they enter college what these lines of work are and have early made up their minds to enter either pure forestry or lumbering. If the percentage were larger it should occasion no great concern, because many boys do not really know what they wish to do until they look for jobs about graduation time. It is fortunate that some graduates find other outlets because it reduces the competition for the available positions. Some men learn in their junior or senior year that forestry is not what they really want to follow, but they continue with the course through graduation to avoid the possible loss of a semester or a year in changing to another department where the requirements may be different. It is really cause for congratulation that so many graduates of our forestry schools, the country over, do stay with forestry or lumbering, because to many of them neither field proves to be what they expected. Forestry has been oversold to many a student. This is as bad as discouraging prospective forestry students by "knocking" forestry as a poorly paid profession (which it isn't).

Of those who took the master's degree in forestry at California, only 4 have strayed from forestry, one of them apparently only temporary. Nine listed as having a bachelor's degree from California obtained a master's degree at another university, and are still in forestry. It is to be expected that close to 100 per cent of this class will stay with forestry or lumbering.

Of the 92 U. of C. foresters who stayed with forestry, 36 per cent are employed by the U. S. Forest Service, and of these, 4 are in grazing work. An additional 10 per cent are in other federal bureaus—Indian Service, Park Service, Entomology, and Pathology—thus bringing the total in federal employ to 46 per cent. I believe this percentage will gradually shrink because other fields are opening for forestry graduates. Incidentally, I can't agree that Guise is right in his implication that greater effort should be made to encourage the young forestry graduate to seek employment in the Forest Service.

In the first place, the Forest Service employs each year only about 50 of those men whose names appear on the Junior Forester register of eligibles. According to the Chief Forester's office, this number is not expected to increase materially in the near future. Distribute 50 among the existing schools, and there are not many men each school can hope to place with this federal bureau. In the second place, if the student gets the idea that only the federal service is worth while, he gets a wrong impression. We have been for some time trying to interest private owners in forestry. It is not consistent, therefore, if we do not rate

private employ as high as federal. In my estimation the really big potential field for future foresters is with private owners. If I am right, I wish more students could see it the same way so that they could now be making their way into lumber organizations in the logging or the manufacturing end and thus bring forestry knowledge and ideas into the personnel and have it ready when it becomes needed. In view of the small number employed each year by the Forest Service and the large number of men graduated, I feel that we should lay more emphasis upon the private fields—whether in forestry or in logging or lumbering pursuits.

The lumber industry in all its branches is waking up to the fact that one of its major difficulties is a personnel problem, and that it cannot much longer worry along with poorly or partially trained men if it is to compete with those industries which are going out of their way to obtain trained men. What does it matter if the forestry graduate goes into a logging camp, a sawmill, or even a lumber sales department, if such work appeals to him? If he had a forestry viewpoint and ideals when he left college, he is more than likely to retain them, although they may have to be held in the background until his company becomes interested in forestry. Lumbermen have told me that the reason they don't employ more forest school graduates is because their training is of no direct value to the employer. They do not have the same feeling toward a graduate in engineering or one with a business training. What they want right now is a group of better trained men who know wood thoroughly—its logging, milling, conditioning, remanufacture, and sale; in short, men who can eventually take responsible positions in a lumber organization and who can make of it a profitable enterprise. As a profession, we are still emphasizing pure forestry more heavily than conditions permitting its practice justify, not appreciating generally that we are handicapping the progress of forestry and the future of young foresters if we continue to look down upon lumbering as being foreign to forestry.

EMANUEL FRITZ.

FORESTRY TRAINING IN HOLLAND

After reading the article upon "Vocational Training in Forestry" in the JOURNAL OF FORESTRY for October, 1928, by Dean Henry S. Graves, it occurred to me that foresters in America might be interested in learning how forestry training in Holland has been organized.

First of all, we have the Agricultural University at Wageningen with sections for tropical and for European forestry. Most of those who have completed their studies at this University and have received their engineer's certificate find a place with the State Forest Service in Holland or the East Indies, with societies, or with private forest proprietors as foresters or estate managers.

The secondary training takes place at the Dutch Society for the Reclamation of Waste Land (Nederlandsche Heidemaatschappij). For this purpose the Society, with funds appropriated by the state, established a school with a two-year course. To be admitted to this school one must be 18 years old, and in addition to a common school education

must also have received some agricultural instruction and have had practical experience in agriculture. During the two five-month winter periods, the students are given theoretical instruction in forestry, culture-technics, surveying, levelling, etc.; while during the two seven-month summer periods, under the direction of expert officers of the Nederlandsche Heidemaatschappij, they carry out practical work in the way of forestry, soil cultivation, planting and sowing, thinning, draining, reclamation, etc. In every case they are compelled to take part in the actual work in hand. The theoretical lessons are given by the officers of the Nederlandsche Heidemaatschappij and of the State Forest Service.

This school has now been operating in this way for 25 years with the greatest success. Experience has shown that a fine type of practical forest guard is produced by this course.

For the past few years the technical forestry training in Holland has been extended by short forestry courses given by the Nederlandsche Heidemaatschappij. There are many private forest proprietors who desire to know a little more about forestry; in addition there are a great number of agents, foremen, etc., charged with the management of woods who really are not sufficiently well up in these matters or who wish to keep abreast of recent development.

For these persons and others interested, courses have been set up in different forest centers of the Netherlands. These courses consist of 10 lessons, followed by an excursion to some forest estate. They are given by the managing director and by officials of the Nederlandsche Heidemaatschappij. It has been found that these courses are well attended and that the participants evince the greatest interest in the work. Such courses supply a real want and I believe this plan might well be followed in other countries.

The courses are organized as follows:

1st lesson: "Preparation of the soil before afforestation." The demands which the trees make upon the soil. Quality of site, altitude, the appearance of hard pan, etc. Soil cultivation, draining, manuring.

2d lesson: "Method of afforestation." Choice of the various kinds of trees, planting or sowing, mixtures, time for planting or sowing.

3d lesson: "Maintenance of the forests." Thinnings, branch-manuring, underplanting and undersowing, mode of regulation, the conditions of the humus in the forest and the influence which can be exerted thereon by the method of management contrasted with clear cutting; description of a variety of silvicultural systems and their application.

4th, 5th, and 6th lessons: Description of the principal forest trees such as oak, beech, chestnut, alder, birch, hornbeam, maple, whitebeam, bird cherry, acacia, ash, Scotch pine, Austrian pine, Corsican pine, cluster pine, jack pine, dwarf pine, pitch pine, white pine, Norway spruce, Sitka spruce, white spruce, silver fir, Nordmann fir, European and Japanese larch, Douglas fir, yew. Concerning these species, the following points are covered:

a. Their principal botanical characteristics.

b. Their demands upon the soil.

c. Their technical value in forest industries, etc.

7th lesson: Description and demonstration of implements, aids, and appliances for the measuring of trees, such as calipers, hypsometers, increment borers,

volume tables, yield tables. Instruction in the measurement of standing and felled timber, form factors, and valuation of young forests.

8th, 9th, and 10th lessons: Diseases caused by the influence of the weather, by unfavorable conditions of the soil, damages and diseases caused by mammals, birds, insects, and fungi, and bird protection.

J. P. VAN LONKHUYZEN,
Director, Nederlandsche Heidemaatschappij,
Arnhem, Holland.

FORESTRY ENDOWMENT IN AUSTRALIA

Mr. R. Grimwade has established an endowment of £5000 for the encouragement of scientific forestry in Australia. The interest from the endowment will be available biennially as a prize to enable a selected Australian forester to study at the Imperial Forestry Institute at Oxford and to visit the forests of Germany and France.

The qualifications for the candidates are the full forestry course at the Canberra school or its predecessor, the Adelaide University forestry course, and in addition, and subsequent to the course, two years in practical forestry work in Australia. A further condition is that the prize winner, after completing his European studies, return to Australia and serve in either a government forest department or in private forestry employ for a period of 3 years.

NOTICE OF ELECTION

In accordance with Article VIII of the revised Constitution as printed in the October, 1928, number of the JOURNAL, page 838, President Redington has appointed the undersigned as the Nominating Committee. This committee has set Monday, December 16, 1929, as the date of election.

The Nominating Committee is now ready to receive nominations from the membership of the Society, each nomination bearing the signature of at least ten voting members to be presented for election in accordance with Section 2, Article VIII, of the Constitution.

The committee nominations together with those already received from the membership must be distributed to the voting members of the Society not later than October 7, so petitions by members should be in the hands of this committee as soon as possible. Petitions received as late as October 26 can be placed before the electorate without the endorsement of the committee. Only one name can be placed in nomination by any one group.

The following positions are to be filled in the December election: President, Vice-President, and four members of the Council. The following members of the Council hold over: Redington, Stuart, Leopold, Munger, Howard.

Nominations may be sent to any member of the committee.

J. S. HOLMES, Raleigh, N. C.
E. I. KOTOK, Berkeley, Calif.
E. S. BRYANT, Boston, Mass.

Grazing in Relation to Forestry in New England[1]

Early in 1928 a special committee of the New England Section, Society of American Foresters, was appointed by Chairman E. C. Hirst to report on the present relation of grazing to forestry in New England and the immediate prospects in this regard. In charging the committee, Chairman Hirst said: "There is a growing interest among the members in the relation of grazing to silviculture. . . . We ought to know how valuable for grazing our woodlands really are, and what harm is done under different forest conditions by the grazing of cattle and sheep. If properly regulated, grazing can help bear the carrying charges without damaging certain kinds of growing forests, we ought to know it."

The subject as outlined for the committee to study is an exceedingly broad one and involves, in addition to silvicultural considerations, many aspects of the question of land use. The work of a committee of this sort is hardly adequate to bring in a report with any claim or completeness or finality. The time and expense required to study individual cases and underlying economic factors are too great. This report is based largely upon the experience of the individual members of the committee, supplemented by a week's field trip by the committee to points of special interest in various parts of New England, where the use of grazing in different types of forest could be studied on the ground.

There are three broad aspects to the subject which will be discussed separately. First of all, we are interested in the possible use of grazing as an aid or adjunct to silviculture and in the dangers from grazing which must be guarded against. This is the silvicultural aspect. It is apparently the only aspect which has been given any consideration in previous discussions of the subject.

Secondly, if grazing can or does take any part in the silviculture of the region, we must consider how grazing management fits in with forest management. This may be called the regulative aspect.

Finally, we must consider the economic aspects of the subject. If grazing holds any possibilities as an aid to silviculture and forest management, we should know in how far present grazing industries will be able to supply the needed stock, and whether the grazing industries are becoming of more or less importance in New England. We might even be carried further to consider whether the economic welfare of the region calls for stimulation of the grazing industries, and if so, how this would affect our program of reforestation.

Silvicultural Aspects of Forest Grazing

As a basis for studying the silvicultural aspects of forest grazing we must con-

[1] Report of Special Committee of New England Section, Society of American Foresters.

sider the various ways in which grazing may benefit the forest and the various forms of damage which may result from forest grazing.

The benefits which may accrue from forest grazing comprise:

1. A lowering of fire hazard by removal of surface vegetation. Under New England conditions any benefit of this sort will be confined to young coniferous stands, principally in the old field type, where the forage may constitute a real hazard. In more advanced coniferous stands there is no forage to support grazing and in hardwood stands no amount of grazing will remove leaf litter unless it introduces grass cover which is in itself a detriment to the stand.

2. Lessening of competition of herbaceous and shrubby vegetation. In the early stages of the stand, grazing may accomplish cheaply and fairly satisfactorily the work of cleaning or control of hardwoods which proves costly if done with the axe. There are a number of important undesirable plants, however, which are avoided by cattle, horses, and sheep, so that no assistance in subduing them may be expected from grazing. Among these plants are the low juniper (*Juniperus communis*), sweet fern (*Myrica asplenifolia*), Connecticut hardhack (*Potentilla fruticosa*), steeple bush (*Spirea tomentosa*), and mountain laurel (*Kalmia latifolia*).

3. Assisting in control of composition of reproduction. Under most conditions grazing of stock (sheep, cattle, and horses) tends to favor softwoods as compared to hardwoods. Since the encouragement of coniferous growth constitutes one of the most important silvicultural problems in New England, properly regulated grazing may render much valuable service in this connection. This applies to the pine region of southern New England as well as to the spruce type of the north.

4. Financial return from grazing use of forest land. In establishing new stands by plantation or in bridging the period between removal of one crop and maturity of the next it may be possible to secure some revenue from grazing which will offset the costs of protection, taxes, and interest. Anything which may be done along this line is extremely desirable, but here again the only type which furnishes forage enough to be of value for grazing is the old field type.

Damage from forest grazing may take the following forms:

1. Devouring of foliage and young growth, especially of hardwoods. As has been stated above, stock generally avoid conifers in preference to hardwoods.

2. Trampling. Damage from trampling is, of course, confined to young trees and is most noticeable in coniferous plantations, where cattle and horses often cause serious side injuries near the ground line of young trees, on which they tread. This injury results either in death or serious deformation.

3. Rubbing. Cattle, especially in the early spring, will injure and often kill coniferous trees 6 to 10 feet in height by rubbing against them with their horns, breaking off side branches, and injuring bark.

4. Compacting the soil and increasing erosion. Heavy and continual grazing of forest lands may result in compacting the soil so as to create conditions unfavorable to any sort of regeneration. On moist sites heavy grazing may compact the soil so as to expose the roots of trees above the sapling stage to an extent fre-

quently resulting in their death. On steep open lands in the process of restocking, heavy grazing may result in breaking up or destroying the sod cover and opening the way for erosion.

The committee believes that no class of stock can be grazed in the forest without causing some damage. The extent and character of the damage depends upon a complex of factors which must be studied for each particular case. Factors to be considered include such things as kind of stock, soil, slope, drainage, climate, season, character and amount of surface vegetation, age and composition of stand and object of management.

The damage may often be reduced to such small proportions as to be more than offset by the benefits from grazing. In order to insure this result, grazing must be carefully regulated as to kind of stock, number of head, season of grazing, and method of handling. In any case grazing use of forest land can only be temporary. Grazing and forestry cannot be permanently combined on the same areas in New England.

Grazing is not advisable in the hardwood types. Although this applies quite generally throughout New England the committee wishes to emphasize especially conditions in the maple sugar orchards of Vermont. The maple sugar industry has proven an important source of revenue and prosperity to this region and its perpetuation is of vital importance to large numbers of farmers in northern New England. In the past it has been the usual custom to use the sugar orchards in summer as pasture for cattle and horses. This practice results in the slow but certain destruction of the sugar bush. The grazing prevents the establishment of maple reproduction. Eventually the old trees die and as the stand opens up grass sod is introduced by the stock. This process continues until there are no more maple trees. While the sugar bush is passing, a scattered understory of hemlock or spruce may become established.

Experience has clearly demonstrated that orchards which have been protected from grazing reproduce nicely. Young trees are constantly growing up to replace those which die or are blown down, and conditions are kept ideal for maximum production of sugar. The presence of undergrowth in the protected orchards does not seriously interfere with the collection of sap if care is exercised in planning and laying out the roads and paths to be used in going from tree to tree.

From this it is obvious that the elimination of grazing is of prime importance in the perpetuation of sugar orchards. If the farmer requires some woodland shelter for the cattle in his pasture, it should be possible to supply this by fencing off a small portion of the woodlot rather than exposing the entire sugar bush to gradual destruction.

The conditions under which regulated grazing can be of most service to the forester are found in coniferous plantations on old fields or open lands, or naturally restocked areas of the same kind. On this type of land the surface vegetation often constitutes a serious fire hazard and may interfere with the growth of the young trees for several years. In addition, hardwoods of undesirable species frequently invade the area and overtop the young conifers. Reduction of fire hazard and of the competition from herbaceous and hardwood growth may be accomplished with neg-

ligible loss by grazing of livestock under proper management, and in this way these old fields may be made to pay their way, in part at least, while the trees are small. Cattle are the most desirable class of stock for this purpose, and these should be limited to the number which the area will support. The damage will be confined chiefly to small areas near bar-ways and other places where animals tend to congregate. Experience indicates that the damage can be kept at a minimum by restricting grazing in early spring and late fall. No winter grazing should be permitted.

The successful use of grazing, even under these favorable conditions, depends entirely upon intelligent and careful supervision. The effect of the stock on the forest trees must be watched throughout the grazing season and the grazing regulated as experience may dictate for each individual tract. It should also be borne in mind that the benefits from grazing in young coniferous stands on old fields for more than the first few years may be obtained only at the sacrifice of the silvical advantages of the possible inclusion of some hardwoods in the stand. Whenever stock are available, and adequate supervision can be provided, grazing of coniferous plantations on naturally restocked old fields should be encouraged in this region, at least for the first few years.

In New England there are limited areas of the spruce and hardwood or pine and hardwood types adjacent to open lands on which grazing may be used to advantage by the forester. On these lands the forester usually wishes to reproduce a high proportion of the softwoods, but finds hardwoods predominating if nature is allowed to take her course. Grazing may effectively keep down the hardwood reproduction and permit the softwoods to become established in large numbers. For this purpose sheep are perhaps the most effective. The difficulty in the practical working out of this problem is that the woodland seldom offers enough forage to attract stock into it to any extent or for any considerable period of time. Browsing animals like sheep will find more to eat than cattle, but even sheep will require access to open land nearby to live properly. The committee believes that wherever suitable conditions exist grazing under proper restrictions may well be encouraged on the mixed types of northern New England as a means of increasing the proportion of softwoods.

REGULATIVE ASPECTS OF FOREST GRAZING

The successful use of grazing on forest lands as a silvicultural or fire protective measure, or as a means of utilization of forage which would otherwise go to waste, is largely a question of control of stock by those who have in mind the improvement or protection of the forest, rather than the welfare or return from the livestock. What is best grazing management for the forest may be the poorest for the stock.

For this reason we must consider how grazing management fits in with forest management and what the viewpoints of the various interests are toward grazing.

In the case of the majority of agricultural land owners the current or annual return from stock as contrasted with the long term return from trees tends to keep their interest in the stock greater than in the trees.

Farmers specializing in stock raising or dairying will generally subordinate the welfare of the forest growth to necessity or convenience in handling of the stock on hand. Only in exceptional cases, such as in the handling of maple sugar orchards, can we hope that they will cut down the size of their flocks or modify their method of handling the stock in order to prevent damage to forest growth or to obtain desirable silvicultural results. On the other hand there are many landowners in New England who maintain themselves from a diversified line of activities on their farms or by working in adjacent towns. Quite frequently such people value their timber lots very highly and might readily welcome any idea that promised to control or improve the reproduction. This class of owners is perhaps in a more advantageous position than any other to make use of regulated grazing in the handling of their woodlands.

When the land owner is primarily interested not in the stock but in the trees, as in the case of public forest administrations, forest industries, or individuals really practicing forestry, the case is, of course, different. Such landowners seldom possess livestock, and so if they are to make any use of grazing in the management of their woodlands they must resort to renting out pasture or to undertaking stockraising as a side line.

Unless good agricultural land is also available, stock ownership would not be profitable for forest industries, because of the necessity for shelter, winter feed, etc., and stock ownership probably never could be undertaken as a function of government by public forest administrations.

Renting of pasture is therefore the principal way in which this class of owners can secure the benefits of grazing for their forest management, and the difficulties which present themselves when this is tried will prove insurmountable in a great majority of cases. One of the principal difficulties to be met is that the forest pasture available may be inaccessible to local herds of stock, or that there are no stock owners near enough to be interested. Even in the more densely settled portions of southern New England this may be the limiting factor. Much of the land which the forester may desire to use for grazing is too poor to be desirable to the stockowner. Again, the necessity for fencing may prove a serious obstacle in the way of renting. Finally, if renting of forest land for grazing is to be successful the control of season of grazing, number of stock, etc., must be carefully worked out, and competent supervision will be essential.

Students of the dairy industry, which is by far the most important livestock industry of New England, are recommending to farmers the production of better grade stock on better quality pastures. The old hill or brush pastures so generally used throughout New England are giving way to cultivated pastures in such crops as blue grass and sweet clover. It is being shown that dairy products cannot be profitably produced on the poor type of pasture offered by forest land. Even for dry cows or young stock more intensive feeding on better and more accessible pastures is being recommended. In view of these facts, it will be difficult to influence the dairyman to use woodland pasture for his stock unless nothing better is available.

A study of the sheep industry in New England reveals that most of the successful sheep growers keep pasture and forest lands distinct and separate. The successful use of forest land for sheep pasture is confined to limited areas under special conditions, such as plantations with abundant forage among the trees and mixed growth adjacent to open pasture, where it is desired to encourage softwoods at the expense of hardwoods.

ECONOMIC AND LAND USE ASPECTS OF FOREST GRAZING

The abandonment of upland farms in New England and their gradual return to forest is a condition commonly accepted as evidence that forest industries rather than agricultural ones are destined in the future to dominate the uplands and poorer soils of New England. So far, this decline in agriculture has carried with it a decline in animal industry.

A century ago New England supported large herds of sheep and beef cattle. Vermont was the leading sheep-raising state of the Union. The sheep industry was one of the dominant agricultural industries in Litchfield County, Connecticut, and important in all rural New England; cattle were regularly pastured on woodland pastures and in hardwood forests. Today the sheep industry is, except for isolated farm flocks, practically a thing of the past. Cattle are no longer raised exclusively for beef, although due to the demands of a large urban population an intensive dairy industry has been maintained. The changing conditions, even in recent years, may be emphasized by the following comment by J. H. Foster, state forester of New Hampshire: "Grazing is coming to be so little practiced among woodlots and pastures that the influence of it is certainly being less felt than years ago when every farmer kept stock. Most of the stock today is on the better class of dairy farms and the cattle do not get into the woods or pastures anything like as much as they used to."

The principal factors in this decline of the sheep and beef-raising industries are competition from the west, including the development of modern packing house methods there, inability of New England to produce its own grain for the long winter feeding required, a world wool surplus as a result of decrease in wool consumption, and, perhaps of more importance than is generally realized, pasture deterioration from invasion of unpalatable plants, shrubs, and trees.

Since under present conditions New England must import a large proportion of its meat and wool, and large areas of abandoned or marginal farm land are still available, the question is frequently asked whether it is possible or desirable to revive the former extensive livestock industries, maintaining as pastures the abandoned farm lands instead of allowing them to revert to forest. If such a revival of the sheep and beef cattle industries could be accomplished the possibility of utilizing regulated grazing as a temporary adjunct to forest management would be greatly increased.

But careful students of the situation seem to agree that New England, despite its closeness to market and its large area of potential grazing land, is apparently at an economic disadvantage in sheep and beef cattle production which is not likely soon to be overcome. Even if economic conditions favored the return of these industries, the widespread

deterioration of pastures and the difficulty of maintaining untillable pasture in good grazing condition against the invasion of such plants as juniper, spirea, sweet fern, Connecticut hardhack, mountain laurel, mullein, or thistle would present serious obstacles. The only hope lies in the dairy industry, and in this the use of forest lands for pastures is not generally profitable or desirable.

From a consideration of all aspects of the subject the committee fails to see that the use of grazing as a silvicultural measure can have any large field in forestry practice in New England. The best that can be hoped for is that some favorably situated owners may be able to use grazing on a small scale in plantations, or to encourage the reproduction of softwoods at the expense of hardwoods in mixed stands.

C. Edward Behre, *Chairman,*
K. E. Barraclough,
P. L. Buttrick,
F. M. Callward,
R. C. Hawley.

Gulf States Section Discusses Forest Policy

At the meeting of the Gulf States Section in New Orleans, April 5, 1929, the following officers were elected for the ensuing year:

Chairman, C. F. Evans.

Vice-Chairman, Gordon D. Marckworth.

Secretary-Treasurer, N. D. Canterbury.

W. L. Hall stated that at the 1927 meeting of the Southern Forestry Research Council, the question of new sections was discussed by a group of members of the Society. An informal agreement was reached to form an Ozark Section including Arkansas, Oklahoma, Missouri, Kansas, and possibly a part of Tennessee. A petition for the new section has been prepared and signatures are being obtained.

Mr. Hall also asked for suggestions for the Society Committee on Forest Policy, of which he is a member. He feels that more authenic information on fundamental forest conditions is greatly needed. It is customary to refer to the Capper Report of 1920, but its information is inadequate. The information obtained should be within 10 to 15 per cent of accuracy. Mr. Hall stated further that the principles of the plan for solution of the forestry problem are already agreed upon and form the basis of the Clarke-McNary and McSweeney-McNary Acts. These are:

1. Fire prevention on a coöperative basis.

2. Research, silviculture, and planting, also on a coöperative basis. Such success as might obtain under the coöperative plan of work would depend entirely on the voluntary acts of the coöperators. Much is expected of the lumber operators, and question would arise as to how to get at sluggish coöperators. A tribunal representing all agencies might serve to reach out to the non-coöperators.

H. H. Chapman remarked that the situation under discussion is an effort to revitalize effort to solve the forestry problem at one full swoop. The earlier attempt resulted in the Clarke-McNary Act, making possible coöperative fire protection. Now Gifford Pinchot and George P. Ahern have put out a pamphlet entitled "Deforested America."

Progress has been made. Government regulation will not work. Professional foresters cannot now reconcile themselves to accept leadership blindly. Some foresters see devastation and think for the moment that the problem can be solved by governmental regulation. This can only be accomplished when a majority of the landowners are voluntarily doing what the proposed regulation suggests. In Finland the government regulates a recalcitrant minority. A similar situation does not obtain in this country. We must get 90 per cent of the landowners practicing forestry and then regulate the remaining 10 per cent. It is very questionable whether the practice of forestry on privately owned lands can be forced on a majority. Forced public ownership might result. One-third of the area in northern Minnesota covered by the Fairchild Tax Inquiry is now publicly owned. If lands are non-productive, tax rate increases will ultimately result in state confiscation of lands.

A. D. Read urged charitable consideration of the timberland owner for his failure to reforest. The public is 90 per cent responsible by unfair and short-sighted valuation for taxing of timber holdings, by failure to pass suitable deferred taxation laws, and by deplorable carelessness with fire. We all want the denuded lands reforested. What scheme will get it done best and quickest? It is not evident how public ownership can work any miracles in this direction. Buying stump land at a fair price from the lumberman would be welcomed by many owners, but to allow conditions to reach such a pass that the land is acquired through the non-payment of taxes will be the poorest management and business. Will public ownership reforest this land any sooner than private ownership? Will the public stand for the necessary bills either in bonds or in taxes? How long would it take any state forestry department now operating in the southern states to finance the reforesting of 1,000,000 acres or even 250,000 acres at a cost for the minimum acreage of at least $500,000? State ownership is not the solution except for small areas. Conditions will have to be made, and it is likely that they will be made, so that it can be done with private capital.

R. L. Hogue remarked that the Southern Forest Experiment Station has data but does not publish it. Forbes' report on southern pines is an example. Some way should be found to expedite publication of this and other reports. After considerable discussion of the subject the following resolution was adopted:

WHEREAS, The protection and proper management of the timberlands of the South is of tremendous economic importance to this region and to the nation, and

WHEREAS, In the conduct of this work the landowners are confronted with many problems which require technical information for their solution, and

WHEREAS, The public agencies now coöperating with the landowners in forest fire protection and other phases of forestry have need of much informational and educational printed material, and

WHEREAS, The United States Forest Service has available, from experiments conducted by its Branch of Research, and from other sources, much information that is sorely needed by these public and private agencies, and

WHEREAS, A great deal of this material remains unpublished in the Research and Public Relations Office of the

Forest Service mainly because of lack of funds for printing,

Now Therefore be it Resolved, By the Gulf States Section of the Society of American Foresters, that Congress be urged to increase the appropriation available to the Forest Service for printing and that every effort be made to reduce to the minimum the time required to review and publish manuscripts dealing with forestry subjects.

J. S. Holmes gave a description of a forest survey in North Carolina and remarked that the counties could transfer to the state tax-delinquent lands. He advocated public ownership, and said that if the National Government can buy forest lands and operate them, the states can do likewise. Further, they can operate just as well on confiscated lands as on purchased lands, but it is better to purchase than to confiscate. The North Carolina Forest Survey was forced upon the State Division of Forestry.

F. W. Besley mentioned a law to permit the redemption of land after reforestation, upon payment of back charges.

L. J. Young stated that the problem in Michigan is entirely different. There the private owners cannot be depended upon; they cut out and leave. The attitude of the average lumberman in Michigan is to cash in and let the state hold the land. Tax delinquent lands must be deeded to the state after five years. Areas are from 40 acres up and are usually scattered and impossible to administer until consolidated. In the meantime, residents in the vicinity strip off the timber left.

There is being conducted a drive by the lumbermen to reduce the present yield tax of 25 per cent to 10 per cent. Some want to list lands so that they can hold it at no cost to themselves for speculative purposes. The growing importance of the tourist industry makes even poor grade forest cover have value.

J. F. Dubuar spoke of the value of State Forests for recreational purposes. In New York more than 2,000,000 acres are state-owned. Land values are high. The situation is not comparable to that in other states because of local degree of wealth. It is possible to pay high prices for forest land of little potential value.

N. D. Canterbury,
Secretary.

California Section Considers Forest Influences

At the meeting of the California Section in Berkeley on April 25, 1929, the results of the election of officers were announced as follows:

Chairman, E. I. Kotok.
Vice-Chairman, Woodbridge Metcalf.
Secretary-Treasurer, M. E. Krueger.

Mr. Lowdermilk discussed the results of an experiment in which he has used a series of heavy galvanized tilted iron tanks filled with soil from several sources in as natural a manner as possible—layer by layer as it came in nature, with the natural litter on the top. Two tanks contained a coarse Sierra soil, two a more compact Sierra soil, and four the heavy local soil found in the Berkeley hills. One tank of each pair was burned over, and artificial rain then showered on the tanks in a long series of experiments which involved everything from rains of short duration to much more serious rains than ever fall in this region. The tanks were arranged so that the mud washed off was caught, as well as the surface run-off and the percolation through the soil.

Enormous differences were shown between the pairs of burned and unburned soils, as perhaps might be supposed. The surprising thing was the fact that the effect of the litter was just as strong under heavy and long continued rains as with short ones. It has always been held by foresters that the litter acts as a sponge holding the water and allowing it to percolate slowly into the soil. The capacity of this sponge has generally been held to be about one-half inch of water, and once it was soaked up its efficiency was supposedly lost. Lowdermilk's experiments show that this is absolutely untrue. It does not serve so much as a sponge as a sieve which breaks up the force of the raindrops and allows the water to soak rapidly into the soil. Lowdermilk sought the cause of this in another laboratory experiment and found that when the raindrops hit the bare soil they stir up the fine surface particles into a thin mud which quickly seals the pores in the soil so that the water runs off in very large quantities. When the surface soil is protected by the litter the force of the raindrops is broken. No mud is stirred up and the clear water sinks down through the pores of the soil without any clogging effect. This proof of the efficiency of litter emphasizes strongly its value in watershed protection.

F. S. Baker,
Secretary.

Election of Members

The following men have been elected to the grade of membership indicated, effective June 1, 1929:

ALLEGHENY SECTION

Junior Membership

Albright, Lewis R.
Buckingham, H. C.
Oliver, Donald A.
Skellenger, Laurence E.

Senior Membership

Demeritt, D. B.

APPALACHIAN SECTION

Junior Membership

Carter, Linton A.
Peterson, W. A.

CALIFORNIA SECTION

Junior Membership

Allan, John W.
Austin, Lloyd
Correll, Lynne M.
Kopenhaver, Ralph W.
Mirov, Nicholas T.
Norton, Henry E.
Parker, Alvin L.
Robinson, Cyril S.
Turnbull, George A.
Zaayer, C. V.

Senior Membership

Jotter, Walter E.
Siggins, Howard W.
Wagener, Willis W.

GULF STATES SECTION

Junior Membership

Conarro, R. M.

MINNESOTA SECTION

Junior Membership

Bean, Leslie S.
Cavill, J. C.
Deen, Joshua L.
Lotti, Thomas

Senior Membership

Bode, Irwin T.

NEW ENGLAND SECTION

Junior Membership

Howard, S. Fairman
Hutchins, Maxwell C.
Kneeland, Paul
Pike, Joseph B.

Senior Membership

Herbert, Paul A.

NEW YORK SECTION

Junior Membership

Luther, Thomas F.
Roberts, Kenneth L.

NORTH PACIFIC SECTION

Junior Membership

Dinehart, Peter M.
Gray, Patrick L.
Holst, Monterey L.
Kolbe, Ernest L.

Senior Membership

Chapler, R. H.
Meyer, Walter H.

NORTHERN ROCKY MOUNTAIN SECTION

Junior Membership

Crossley, Thomas
Hatch, Alden B.
Kemp, Paul D.
Morris, Elliston P.
Rowe, Percy B.
Sharp, Andrew G.
Spaulding, Clarence K.

OHIO VALLEY SECTION

Junior Membership

Bartlett, Ile H.
Booth, I. S.
Dearborn, Ned
McIntire, George S.
Norton, Newell A.

Senior Membership

Day, Ralph K.
Deam, Charles C.
Telford, C. J.
Wilcox, Ralph F.

Associate Membership

Wight, Howard M.

SOUTHEASTERN SECTION

Junior Membership

Sanders, A. Leslie

WISCONSIN SECTION

Junior Membership

Kilp, Frederick G.
Nelson, Stanley C.

Senior Membership

Hammer, George C.

Announcement of Candidates for Membership

The following names of candidates for membership are referred to Junior Members, Senior Members, and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the April Journal, without question as to eligibility; the names have not been passed upon by the Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before September 15, 1929. Statements on different men should be submitted on different sheets. Communications relating to candidates are considered by the Council as strictly confidential.

FOR ELECTION TO GRADE OF JUNIOR MEMBER

Name and Education	*Title and Address*	*Proposed by*
Barr, P. M. Yale, M. F., 1925, Ph. D., 1929	B. C. Forest Service, Victoria, B. C.	H. S. Graves S. J. Record R. C. Bryant

Name and Education	*Title and Address*	*Proposed by*
Bateman, B. A. La. State, B. S. F., 1926	Great Southern Lumber Co., Bogalusa, La.	Gulf States Sec.
Beedon, O. L. State College of Washington 3 years	U. S. F. S., John Day, Ore.	North Pacific Sec.
Bodine, Roger Campbell Oregon State, 3½ years forestry	Assistant Forester, Los Angeles Co. Forestry Dept., Los Angeles, Calif.	California Sec.
Burroughs, Isaac C. Univ. of Idaho, B. S. F., 1927	Texas Forest Service, Lufkin, Texas.	Gulf States Sec.
Bull, Henry Yale, B. S. F., 1927; Yale, M. F., 1929	512 Norton Street, New Haven, Conn.	New England Sec.
Clouston, John G. Washington State, 1923, B. S. A.	Box 119, Pendleton, Ore.	North Pacific Sec.
Downey, E. J. Iowa State	Coushatta, La.	Gulf States Sec.
Dunn, L. D. Penn. State, B. S. F., 1916	Assistant Forester, Dept. Conservation & Development, Branchville, N. J.	Allegheny Sec.
Goodspeed, Allen W. Univ. of Maine, B. S. F., 1928; Yale, M. F., 1929	Bantam, Conn.	New England Sec.
Ireland, Russell A. Univ. of Mont., B. S. F., 1920	Assistant Forester, Los Angeles Co., Los Angeles, Calif.	California Sec.
Kirkpatrick, John Common School. Read and studied on forestry subjects	Randle, Washington.	North Pacific Sec.
Kotz, Harold D. N. Y. State, B. S. F., 1926	Assistant Production Manager, Bethlehem, Pa.	Allegheny Sec.
Lockyer, Scott S. Univ. of Maine, 1908. 2 years in forestry	Brown Company, Berlin, N. H.	New England Sec.
Middleton, Newell M. N. Y. State, B. S. F., 1924	Ass't to Vice-President of Plant & Production of furniture and cabinet work, Bethlehem, Pa.	Allegheny Sec.
Mitchell, Glenn E. Washington State, one year	Okanogan, Wash.	North Pacific Sec.
Moore, William Harry, Jr. Penn. State, B. S. F., 1923	Forest Engineer, James D. Lacey Co., Jacksonville, Fla.	Southeastern Sec.
Payne, Montgomery A. Univ. of the South, B. S., 1927; Yale, M. F., 1929	Winterville, Miss.	Gulf States Sec.
Schubert, Benjamin L., Jr. Penn. State, B. S. F., 1915	General Wood-Working Problems, United Shoe Machinery Corp., Brockton, Mass.	New England Sec.
Seigworth, Kenneth J. Penn. State, B. S. F., 1929	District Forester, Salisbury, Md.	Allegheny Sec.
Story, H. D., Jr. Louisiana State, B. S. F., 1928	American Forestry Assoc. Amite, La.	Gulf States Sec.

Name and Education	*Title and Address*	*Proposed by*
Thompson, Robert Elmer Mich. State, B. S. F., 1910; Yale, M. F., 1911	Assistant County Forester, Los Angeles, Calif.	California Sec.
Toler, J. B. Louisiana State, B. S. F., 1928	Jackson, Miss.	Gulf States Sec.
Van DeWalker, Charles A. N. Y. State, B. S. F., 1925	District Ranger, Tahoe National Forest, North Bloomfield, Calif.	California Sec.

FOR ELECTION TO GRADE OF SENIOR MEMBER

Bowman, Arthur B. Penn. State, B. S. F., 1924 (Junior Member 1295)	Junior Forester, Libby, Mont.	No. Rocky Mt. Sec.
Gurley, Henry H. N. Y. State, B. S. F., 1926 (Junior Member 1926)	Junior Forester, Cœur d'Alene National Forest, Cœur d'Alene, Ida.	No. Rocky Mt. Sec.
Myers, Frank B. N. Y. State, B. S. F., 1913; M. F., 1914 (Junior Member 1925)	Member of faculty, N. Y. State College of Forestry, Syracuse, N. Y.	New York Sec.
Nix, Leon A. N. Y. State, B. S. F.; M. F. (Junior Member 1923)	Manager, Woodlands Dept., Bathurst Power and Paper Co., Bathurst, N. B., Canada.	New York Sec.
Peterson Carl, I. Pa. State, B. S. F., 1919	Nashville, Tenn.	Appalachian Sec.
Williams, W. K. Yale Univ., M. F., 1921; Stockholm Univ. Forestry 1922 (Junior Member 1923)	Extension Forester, Univ. of Arkansas, Little Rock, Ark.	Gulf States Sec.
Wohlen, Paul A. 2 years Univ. of Norway (Junior Member 1923)	Forest Supervisor, Clearwater National Forest, Orofino, Ida.	No. Rocky Mt. Sec.

FOR ELECTION TO GRADE OF ASSOCIATE MEMBER

Dormon, Miss Caroline Judson College, 1907	Chestnut, La.	Gulf States Sec.

FOR ELECTION TO GRADE OF HONORARY MEMBER

Merriam, Dr. John Campbell Lenox Coll., B. S., 1887; Univ. of Münich, Ph. D., 1893; Columbia, Sc. D., 1921; Wesleyan Univ., LL. D., 1922	President, Carnegie Institution, Washington, D. C.	Washington Sec.
Pratt, George D. Amherst, A. B., 1893	President, American Forestry Association, Washington, D. C.	New York Sec.

B. A. CHANDLER,
Member of Council in Charge of Admissions.

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Aldo Leopold	Dec. 31, 1931	W. G. Howard	Dec. 31, 1933
T. T. Munger	Dec. 31, 1930	Ovid M. Butler	Dec. 31, 1929

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